



# DEHYDRATION

## Its Post-War Future

by

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President of the National Dehydrators Association

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First Edition

Publishers of

**FROZEN FOODS**  
and The Locker Plant

*and the*  
**DEHYDRATED FOODS  
SECTION**

To

ARNOLD C. DICKINSON

whose aid and support in the develop-  
ment of the dehydration industry has  
been outstanding for many years.





## PREFACE

This is not a technical book. It deals principally with the future niche of dehydration in the food industry more comprehensively than has ever been attempted before. *Dehydration, Its Post-War Future* is the result of years of practical production and selling experience on the part of the author, Lawrence K. Harper, in food dehydration. As president of the National Dehydrators Association, and of Sardik Food Products Corp., Mr. Harper has perhaps the widest and most varied background in dehydration marketing and merchandising in the country. His contacts with government agencies, both American and foreign, have given Mr. Harper a broad conception of dehydration's post-war place both nationally and internationally.

This volume will be of interest to everyone who wants to know more about dehydration: the dehydrator, the canner, the distributor, the industrial and institutional user of dehydrated products, as well as the prospective producer and merchandiser. Government agencies will find the book of particular value, as well as those looking to investment possibilities in the dehydration field. Advertising agencies and merchandising men will find this book of great help in providing a key to future advertising opportunities.

Mr. Harper has written a highly analytical and frankly critical book about the whole subject of dehydration, its brief past, its volatile present and its hopeful future. He touches on almost every possible phase of the subject, baring the industry's weaknesses and uncovering hitherto unsuspected possibilities.

*Dehydration, Its Post-War Future* is a must on the reading list of everyone who wants to know the future possibilities in the process of dehydration. We are pleased to present this volume to those who do not regard the present processing technique as the final word in the dehydration picture but who can visualize in the tremendous inherent savings it is capable of effecting a great potential food processing system, still imperfect but well on the way

THE PUBLISHER.

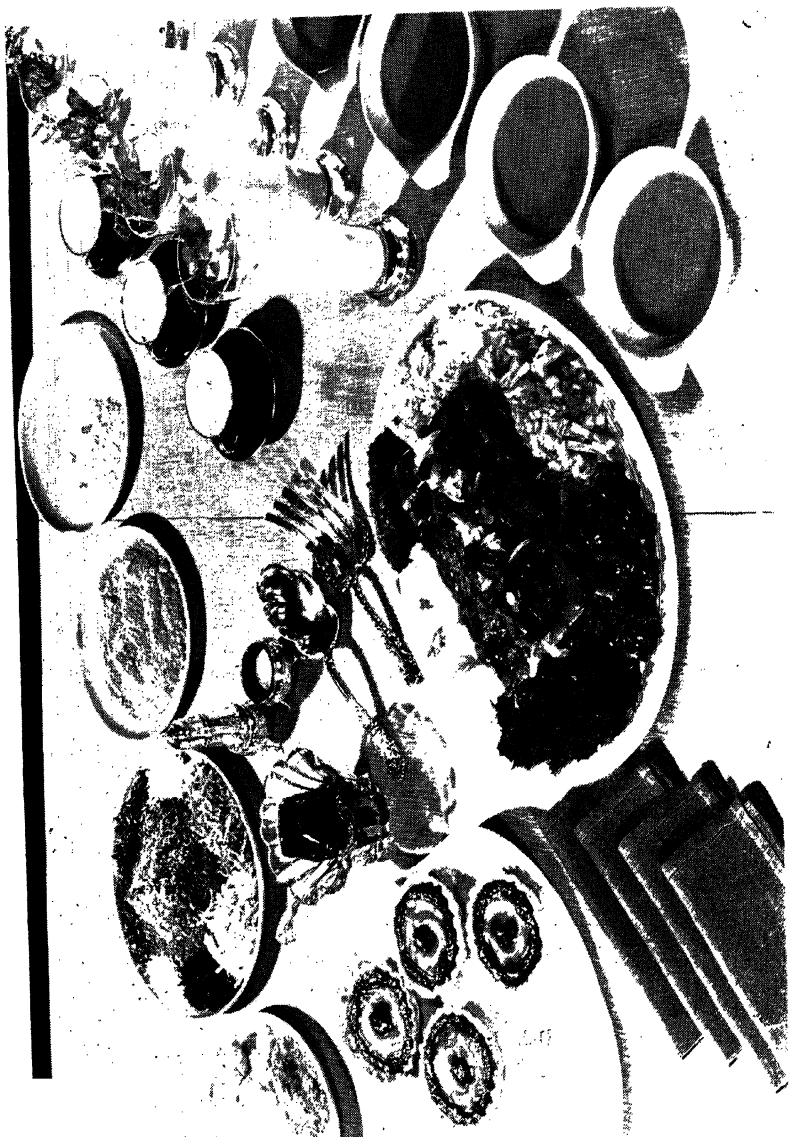


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Dehydrated foods ready to serve. (Courtesy Click Magazine)

## CHAPTER I

# REDISCOVERING A FOOD INDUSTRY

What is the post-war future of dehydrated foods? That is a question on the lips of practically everyone in the food industry and of many outside it. What place will dehydration take among the other food processes and where will the principal markets lie for such foods? Is dehydration purely a war bubble, bound to burst when the conflict is over, or, will its inherent advantages build a great new industry in time to come?

This volume is not presented as the final answer to all these and many more like questions. But it will attempt to treat each phase of the industry in such a way as to shed some light on the final outcome. The book purposely is not written from a technical standpoint since drying systems now in use may be obsolete six months after the war. Rather, it treats with the basic elements of the industry as they dovetail into our national and international economy.

Dehydration is the oldest, and heretofore, the most neglected known form of food preservation. In giving thought to dehydration, it is necessary to consider it from the standpoint of the food requirements of the world and not alone of those of our own country. It may be necessary to devote a large percentage of our acreage and resources to the development of additional plain foods for shipment abroad. The greatest burden on us may be the first two years following the war while impoverished countries are getting back on their feet. At the same time a world-wide movement will be in process to improve agricultural conditions in other nations and a large market will exist for the exportation of dehydration equipment which is being perfected here.

**Dehydration for Home and Abroad.**—Thus, dehydration must be considered from two standpoints: first, as a home industry, and second, as a broad international program for needy nations

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now and immediately after the war. It is not intended to convey the thought that some of the programs under discussion of feeding American dehydrated foods to other nations will be carried out in full. Many things may happen to make such an extensive plan unsound. We should realize, however, that for the present, at least, such projects are in the minds of some of our government officials. But for a more immediate and practical point of view, our domestic market offers both problems and opportunities galore.

**Don't Judge Hastily.**—In judging dehydrated foods, it seems unsafe to estimate the industry's future merely by sampling miscellaneous foods processed under wartime pressure. The unknown factor of technological and scientific improvement in the quality of dehydrated foods must be considered before a fair verdict can be rendered. Scientific improvement is going forward at an astounding rate. At the present writing, the winter of 1943, there are several new systems of dehydration beyond the experimental stage, some of which may well prove to be superior to any now in use.

**Definition.**—Commercial dehydration is the modern industrial application of a primitive domestic art. Modern science has taken the oldest known process of food preservation and adapted it to the exigencies of the present century. In simple terms, dehydration means practically complete elimination of water content from foods by a scientific process which retains nutritive values and vitamins. The moisture content of dehydrated foods will vary according to product and process, but, generally speaking, dehydration removes 93% to 98% of the water in the original food, reduces the weight to one-tenth of the original and the bulk to a somewhat lesser degree.

**History of Dehydration.**—Dehydration is as old as civilization. Passing centuries only have added new techniques to a fundamental process. Explorers have found remnants of dried foods in prehistoric cave dwellings. Vases containing sustenance for the future life have been discovered in early Eastern tombs. Marco Polo, the famous world traveler of the thirteenth century, reported that dried milk was used by the Tartars. In this country, early settlers found a basic staple in the diet of the Indians was pemmican, made of dried beef and venison, crushed to a powder and added to fat and acid berries. The mixture, which would keep indefinitely, was of inestimable value in a society where the food supply was primarily seasonal. Following the example of the aborigines, the colonists in New England dried corn after cooking.

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This was known as "samp." They also dried fish. Peas were dried, and, in the West, beef (known as jerked beef) and buffalo meat. Apparently, from earliest times, fruit was dried in California.

Sun-drying, as practiced thousands of years ago, is still used extensively. Farmers in many sections of the country dry substantial amounts of food for winter use. The dried foods do not taste like fresh and are not expected to; they simply add variety to a somewhat restricted diet.

**Started in 1795.**—The first record of drying by artificial means is in Europe in the eighteenth century when vegetables were treated with hot water before exposure for drying. The same method was also applied to meat. The first dry house, heated by a stove with racks for drying, was conceived by Eisen in 1795. Numerous others were built in Central Europe. Two Frenchmen, Masson and Chollet, are credited with originating dehydration by slicing vegetables, drying them at a low temperature under a controlled air flow, and compressing them by hydraulic pressure. One hundred years ago in France, Nicholas Appert, who originated canning, is said to have dried milk. The commercial process has a history of about 50 years in this country.

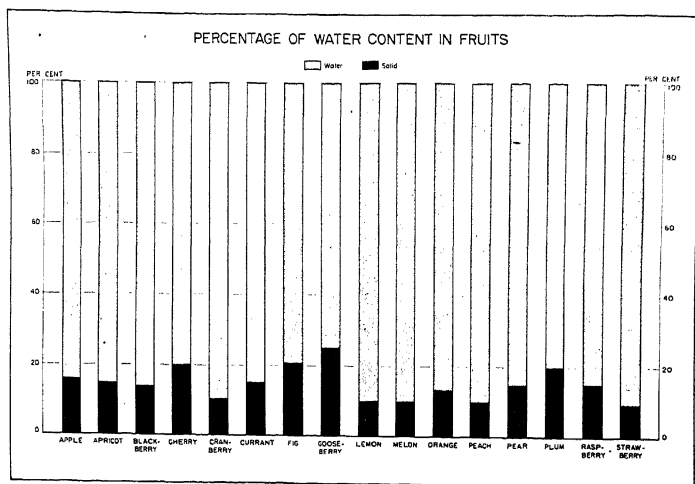
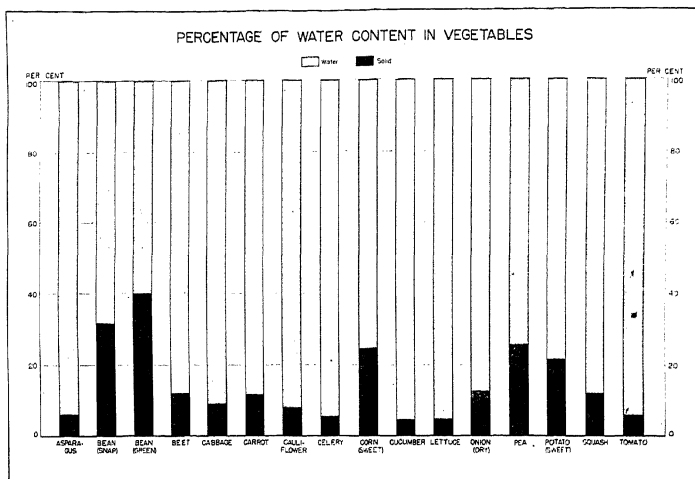
During the Boer War, thousands of pounds of mixed dried vegetables were sent to the British Army in South Africa to be used as a basis for soups. A certain amount of this was manufactured in Canada. Although many technical developments have followed, it is interesting to note that several thousand pounds were left over and were used by troops in 1914. Military records indicate that dried compressed vegetables were used in the Civil War. Experiments with desiccated foods and concentrated milk were not popular with General Sherman's soldiers who called them "desecrated" and "consecrated." The former were used as a possible preventative for scurvy.

Commercial dehydration of potatoes began in Australia and was taken up, without success, in the western states in 1896 with the rush to the Klondike. Dried potatoes were imported from Germany and sold to the miners. In 1910, an enterprise for dehydrating vegetables was established in Oregon but it is reported that two-thirds of the production was unmarketable due to scorching and mold damage.

**Experience in 1917.**—While we know of instances in which dehydrated foods were used in the Boer, Civil, and Spanish-American



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wars, real production of fruits and vegetables in this country began in 1912 and only assumed fair proportions in 1917 when approximately 12 million pounds were produced. Over 8 million pounds were vegetables shipped overseas for the A.E.F.; 6,437,430 pounds of which were potatoes. According to a government publication, even the industry agreed that the products tasted like nothing resembling vegetables. There were no standards required of the manufacturers as to flavor, color or food value. Rules for use and preparation had not been defined. Colorless and far from palatable, the dehydrated products of World War I gave the industry a bad name. Soldiers refused to eat them, and, upon their return to this country, condemned them so flatly that the industry was practically knocked out.

Although our earliest knowledge of modern dehydration came from Europe, aside from the idea, we imported very little in the way of trained personnel. In Axis countries, however, the industry expanded from three small plants in 1898 to about 1,900 in 1939. In addition, it is reported that 2,000 breweries were utilizing part of their equipment in the process during World War I. In sharp contrast, in the United States there were about 25 establishments in 1919.

When hostilities ceased, dehydration went into a decline. Some products were available, such as gelatin, instant coffee, powdered skim milk, onions, and eggs; but few others reached the retail stores. Bakeries and commercial users absorbed the dwindling supply. Seven years after the Armistice, wartime dehydrated vegetables were lying about in cans which were worth more than their contents. The government had difficulty in using up the surplus, even as animal feed.

**Between Two Wars.**—By 1924 the industry was at its lowest ebb. Sales of potatoes, pumpkin, squash, onions and one or two other products had reached one or two million pounds per year but had failed to maintain their markets. It was not until about 1926 that the present revival got under way. Progress for the next twelve years was painfully slow. However, during this period the industry gained experience and made many improvements. New groups entered the field about 1930; new theories were formulated and different methods devised. For the first time the industry was given hope that superior products ultimately would be made available to consumers.

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In contrast to the general retrenchment in the fruit and vegetable sections of the industry, the net increase in consumption of dehydrated milk during the period 1936-1940, was nearly 49% or 214,619,000 pounds. The supply of dehydrated eggs, imported mostly from China and used by food manufacturers and bakeries, was cut off by the Japanese invasion of Asia. This supply amounted to only 9 million pounds in 1939.

The improvement in dehydrated foods went practically unnoticed in the United States before 1939. Consumer demand was small and the industry was making very little money. In many cases, profits did not permit the purchase of new equipment which was necessary if full advantage was to be taken of new discoveries. However, a few enterprising companies continued pioneering work and brought out several dehydrated products. These were usually distributed through small subsidiaries created for the purpose.

**World War II.**—At the outset of World War II, there was little interest in expansion of the industry on the part of our allies, and there was little support from the United States government until the fall of 1941. After Pearl Harbor, real consideration was given the problem and by late February, 1942, officials had mapped out a program for supplying dehydrated foods to our armed forces and fighting allies. It is currently estimated that to meet wartime demands, vegetable and fruit dehydration will have expanded 400% by the end of 1943, which is almost equivalent to the effort required of the aircraft industry.

The total poundage which the industry has been asked to produce during the government's fiscal year, 1943-1944, is 400 million pounds of fruits and vegetables, 250 million pounds of soups, 700 million pounds of dehydrated milk, 400 million pounds of eggs, 60 million pounds of meat, or more than a total of 1,810,000,000 pounds with a market value of approximately \$800,000,000. All of this food is to be produced by about 700 plants worth approximately \$150,000,000. This, then, is the industry as we find it at the close of 1943.

## CHAPTER II

# REDUCING COSTS THROUGH PROCESSED FOODS

**Cost of Distribution.**—Present wartime conditions have developed many changes in our thinking about a wide variety of industries, particularly in the food field. Among those studies which have been brought to the fore is the cost of distribution. We have come to realize rather suddenly that it costs a lot to do things in this country. Our habits are expensive. We have learned to demand many unnecessary services, all of which have so added to the price of things that they are not worth what we pay for them.

The cost of distribution, we believe, is entirely too high. This is not an accepted fact but has been the subject of controversy for years. Until now we have been content to pay to get the added services which manufacturers and distributors have provided. However, with the cost of living advancing 28% to 30% in recent years, we may not continue to want them in the future unless they can be obtained for less money.

Approximately 59¢ of the consumer's food dollar is the cost of distribution from point of growth to consumption. Even those who do not admit that the figure is too high will concede that it prevents the distribution of enough food to the lowest income groups. It is generally admitted that the enormous waste of surpluses in this country, amounting to as much as 50% of some crops, cannot be overcome completely under the present system of distribution. Even if the food were practically free at the point of growth, it would cost too much to get it where it is badly needed.

In general, the costs of distribution are merchandising, financing, handling, storing, and transportation. Under merchandising are included selling, advertising and display point or point of contact with the consumer. This is usually a retail outlet, department store,

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or market place. If costs are stated correctly at 59%, the remaining 41% includes the costs of planting, harvesting, and manufacturing or processing where it is necessary.

The standard of eating developed in this country has been made possible to a large degree by our methods of preserving foods. Therefore, it is important for us to examine these costs rather than those of the strictly fresh produce.

**Food Costs Can Be Cut Through Processing.**—Before taking up the distribution of processed foods, however, we would like to say parenthetically that many of the high costs reflected in these products are also found in the final cost of fresh foods available particularly in great metropolitan centers such as New York or Chicago. These cannot be grown in big cities and must be transported one way or another, even from points a thousand miles away. The problem of whether or not they can be delivered any cheaper depends quite clearly on two things: transportation and the elimination of unnecessary services, or, to state it differently, devising a method of delivery to the consumer without so many intermediate costs and handling charges. The form of the products is not changed. If the housewife wants them fresh, she takes them as they are. Of course, she could stop buying fruits and vegetables out of season. Instead of buying "green wrap" tomatoes grown in the South for consumers in the North, for which the rate is based on the grower's charge of \$80 to \$120 a ton, purchases of tomatoes could be confined to the summertime when the rate is \$15 to \$20 a ton. In this case, the winter diet would not be as interesting and varied. Consumers might tire of so much canned goods but their food budgets would be reduced.

It is in the ever growing demand for processed foods of all kinds that we find ways and means of reducing our food costs.

Processing, properly done, involves purchasing the raw material at or close to the point of manufacture. This eliminates the terrific costs of handling, of transporting over long distances, and of storing fruits and vegetables in their fresh state which, in many cases, means refrigeration, and, under any circumstance, considerable expense.

Food processing has proved to be a great boon to fast growing America. It has preserved a high percentage of our foods and made possible a wide variety for a greater proportion of the population than would have been possible otherwise. We are so accustomed to seeing thousands of canned and packaged items in a



Representative group of the dehydrated foods packed for the retail trade

grocery store that we cannot conceive the difference it would make if they were not available. No other country in the world, with possibly one or two exceptions such as Canada and England, comes anywhere near being such a "tin can country."

### **New Food Systems Born of Revolutionary Developments.**

—If you admit there is no question about the need of processed foods or the place that they hold in our scheme of things, the point then is to find how to reduce their cost and increase their availability to low income families.

About every ten years there is brought forward some new or revolutionary way of doing things. It may be that the idea is as old as history itself but has never caught on, so to speak, or perhaps the time has never been just right to make the public realize its value and importance. Often revolutionary developments are brought about by wars, great depressions or other unusual conditions. Such developments have taken place in the distribution of food. It was during the first World War that the canning industry really came into its own. Its progress from that point is apparent to all and its value almost beyond estimation. A decade ago the freezing of foods began to assume respectability and proportion. The possibilities of this method of preservation have been developed with amazing rapidity during the past three or four years until now such foods are an accepted fact and are purchased without question.

**Purpose of Dehydration.**—Dehydration now comes along: a method which does not seek to retain the form of foods even to the extent that canning does but which is designed to preserve the essential values without the unnecessary ingredient, which is water.

Before canned foods were accepted generally, we had packaged foods. These were sold in containers with an eye to convenience in handling rather than safety in preservation. Food was bought in paper bags that had come to the grocer in barrels and large boxes. The method had every possible fault with the exposed barrels of food sitting around in a not too clean grocery store, the flies getting the first crack at them and the more dangerous but less well known forms of bacteria growing apace. We got by but nobody knows how much damage some of these foods did to our health. Canned goods gained acceptance slowly because it meant a great change in distribution. People interested in the old-fashioned methods hated to change their ways, to invest in new equipment,

to scrap valuable assets and to put hard earned money in "new fangled" ideas. However, the advantages were too great to be passed up. The fear of the tin can was found to be without foundation. The food was well preserved and tasty.

When frozen foods first came upon the market, many people would not touch them. There were all kinds of objections. At first, as in the canning industry, there were good and bad products. Gradually, as freezing methods improved, the quality became uniformly better and they were found to be acceptable and worth the higher price which had to be paid. The cost of keeping them in proper condition makes them more expensive than other forms of processed foods, thus at present limiting their purchase in the main to the relatively high income groups.

While canned goods and then frozen were coming into prominence, the old packaged foods, which are now so ridiculed, were eased out of the picture. However, they did not disappear but instead, changed their form and character. Today, they are just as important as the canned.

**Many Dried Foods Long Accepted.**—Packaged foods in modern dress are seen in all grocery stores by the hundreds of items: cereals, desserts, seasonings, bakery products and dozens of other classifications. They are perfectly preserved and free from bacteria, insect infestation, and all the other troubles which accrued to the earlier types. The average person buying these products perhaps never stops to think of them as dried but they are.

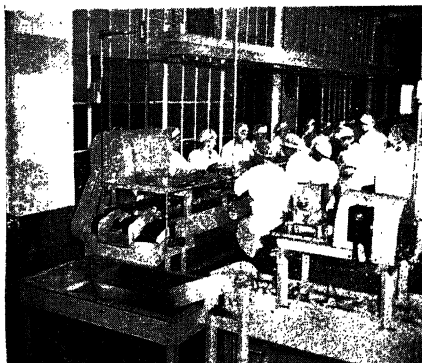
Today dehydration is the word given to the latest type of food which is available in form similar to that of packaged foods. They look alike. They are treated the same way and used for the same purposes. They are new "specials." A two thousand year old method of food preservation has taken on a new guise. This has happened at a strategic time in the history of our nation, a time of war and post-war feeding problems of unprecedented magnitude.

Dehydrated foods can be processed to be just as acceptable to the housewife as canned or frozen. Naturally there are differences in quality among the different manufacturers just as in the case of any product but the average of all dehydrated foods has risen steadily and post-war production should meet exacting standards.

Keeping this in mind, let us see why and how dehydration may lower food costs and help to stabilize our standard of living.



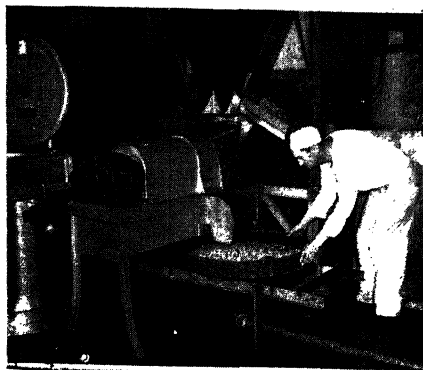
## SOME STEPS IN CARROT DEHYDRATION



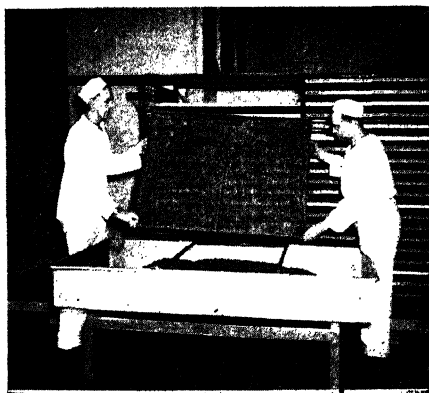
1. After washing, carrots drop into chute from conveyors.



3. The carrots have been raked onto trays which are placed in a rack at the tunnel entrance. They will now travel through the tunnel, subject to degrees from  $160^{\circ}$  to  $210^{\circ}$ . 10,000 pounds can be dehydrated in 20 hours.



2. Cutting comes next. Cut carrots are loaded into round trays for blanching which follows.



4. Carrots immediately after they have come out of the tunnel. Trays here are emptied after which the products will be inspected, weighed and packaged.

(Operations at the Beech-Nut Packing Co. plant at Rochester, N. Y.  
Courtesy of Quick Frozen Foods.)

## CHAPTER III

# DEHYDRATION'S PLACE IN FOOD ECONOMY

**How Foreign Countries Have Used Dehydration.**—Dehydration attacks the problem of distribution from the economic side. Dehydrators do not claim that their products necessarily are better than other types. They do claim equal quality at a lower consumer cost.

The processing of any fresh food by dehydration or otherwise does not improve the original but only attempts to preserve the quality with which the manufacturer started. The efficient dehydrator removes the water, which is unnecessary, and preserves all the essential food elements. The water can be added at the point of consumption. Elimination of bulk makes it possible to avoid the serious economic waste arising out of high transportation, handling and storage costs.

Probably there will never be a better example of the efficient use of a food in wartime than that of dehydrated foods by the Axis to help speed their operations. In the early stages of World War II, everyone was amazed by the extremely rapid advance of large bodies of Axis troops. This was made possible in part by dehydrated foods which permitted packing many days rations in a small compact kit that each soldier could carry. Use of dehydrated foods eliminated four out of every five trucks, cars, or ships formerly needed for the feeding of an army. It is said that airborne German troops invading Crete carried with them 15 to 18 days supply of food, enough in the opinion of the High Command to feed the invading forces without the necessity of transporting any other food. During the invasion of Norway, numbers of isolated groups of Norwegians were overcome by the Germans largely because their food supplies were cut off. The Germans carried theirs on their backs.

Dehydrated foods offer a pattern of economy, speed, and flexibility which is necessary in the efficient handling of all food problems — a pattern that fits in with modern times.

**Surface Unscratched on Savings Through Dehydration.—**

The full extent to which the use of dehydrated foods may save commercial costs has not been considered even remotely. To date energies have been used almost entirely to provide as quickly as possible and in the largest possible quantities a few staples for our armed forces such as eggs, milk, vegetables, and soups. That these foods have been a great aid in the prosecution of the war is too evident to need explanation. In providing vast amounts of food for millions of fighting men in Russia where the means of transportation are limited, and for the Chinese where they are even more limited, and for our armed forces in the islands of the Pacific, and in covering thousands of miles to carry supplies and equipment to the English in North Africa, we know that the ability to eliminate water from foods is an incalculable advantage.

The Axis countries have multiplied approximately 1900 dehydrating plants existing in 1939 to over 8000, including mobile units. By comparison, we have less than one-fifth this number in operation today and very few if any of these are occupied in developing the commercial possibilities of dehydration.

It is asked why Europeans eat so much dehydrated food. The answer is that it always has been necessary for thickly populated countries to conserve every bit of food which could be grown. Dehydration was the method adopted in large part since it is the most economical method known for the preservation of food. Europe has learned over a period of hundreds of years a lesson which we may yet have to learn: that we cannot waste our bounty recklessly. We must learn to conserve our resources. They are great but not limitless.

Europeans have found dehydrated foods to be good, palatable, and nutritious, also that they reduce costs. If Americans give them a fair post-war trial, they should reach the same verdict. If they do, they will be used universally. If they do not, the industry will relapse into its insignificant proportions of 1939.

**40% to 50% of Crops Sometimes Wasted.—**Before enumerating the possible reductions in the overall cost of production and merchandising of foods through dehydration, it is first necessary

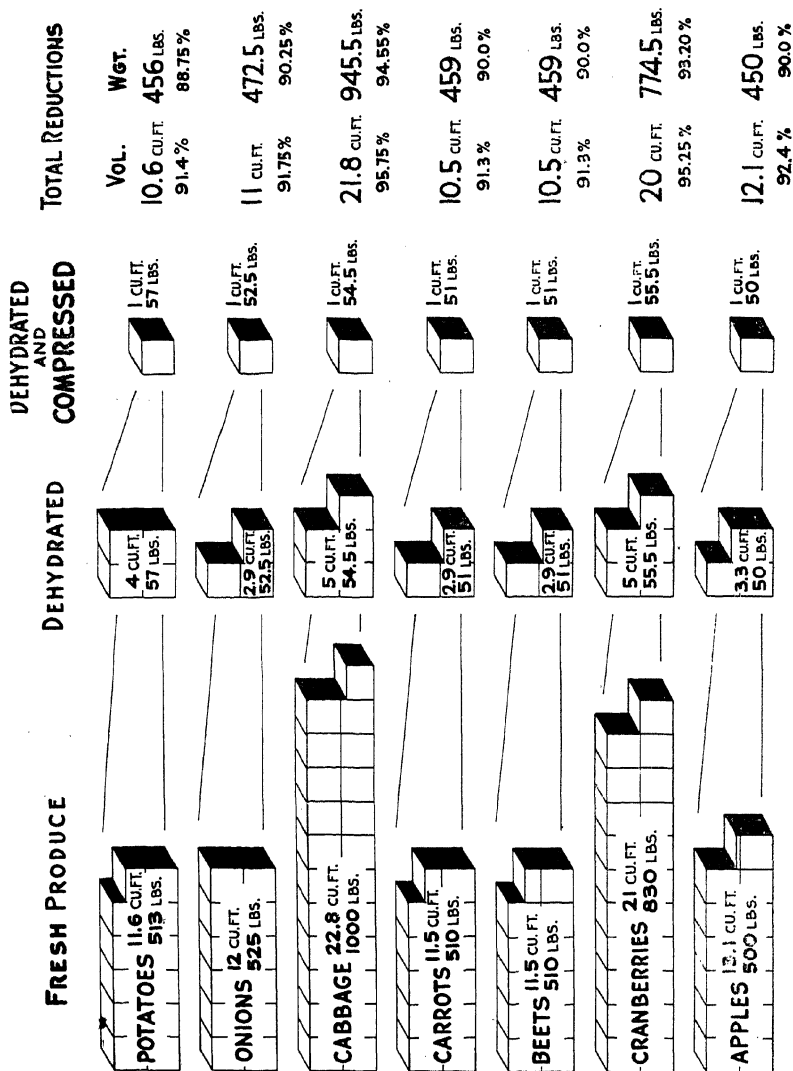
to look at the general picture of food distribution in the United States. There is plenty of land to raise an abundance of everything. Although we import certain agricultural products, authorities agree that nearly all essential crops for a population of 180 million people could be grown in this country. Until recently, there were no restrictions on how much a farmer could raise if he wanted to, no limit to the quantity or variety a manufacturer could make or the amount of food which the consumer could purchase if he had the money. To get a clear picture of the situation, it is necessary to eliminate consideration of wartime conditions and restrictions.

On an average, three years out of four, more food is produced in the United States than is consumed. Every year there is allowed to go to waste as much as 40% to 50% of a fruit or vegetable crop. This is only the amount which is not harvested. If what is spoiled after processing or in the market were included, the percentage would be higher. It is not always the same crop. It may be many crops. Since it is impossible for man to regulate the forces of nature except to a limited extent, there are always going to be good and bad crop years. There will always be floods, droughts, unusual freezing spells or exceptionally hot weather, any of which will seriously affect available food supplies in different parts of the country.

**Leveling the Peaks and Valleys.**—As a result of surpluses or very short crops, there exist extreme fluctuations in prices varying as much as 50% to 100%. If all the surpluses could be harvested each year and stored for use during the periods of short crops, not only a standard amount of food could be assured every citizen every year but the peaks and valleys in price fluctuations could be leveled.

Nature dehydrates for us our great grain crops like wheat, oats, rye and corn, thus putting them in a form which permits us to store them for long periods and to carry over surpluses from rich years for use in lean periods. Mechanical dehydration will do the same for our surplus crops of fruits and vegetables.

The ideal situation is not accomplished by the ever normal granary theory which is trying to guess what nature will do this year or next. It is not fighting nature. It is not scarcity economy. It is merely accepting the situation and using our best efforts to cooperate with nature by preserving what it offers us.



(Courtesy U. S. Dept. of Agriculture)

In past years so many scientific theories of food and price adjustment have been tried unsuccessfully that the country is pretty well convinced that nature is too big for man to fight. Why not work from the other side of the problem and adopt ways and means of preserving all foods?

**Seconds and Culls Are Wasted.**—Recently an effort was made by the government to provide a market for surpluses, including culls and seconds. Stamp plans were inaugurated to create an interest in these products. Prices were generally lower than for other staples available to the retailer at the time. The government followed the theory of keeping prices up and maintaining fair margins of profit on what actually could be sold. To accomplish this end, they often bought up large amounts of seconds and culls and destroyed or left them to spoil. This action prevented flooding the market and lowering the price for standard grade A products, but it did not add to the wealth of the nation. Actually, it promoted destruction. Frequently the following year it would be necessary to pay a premium for the same crops in order to satisfy the demand. Under present marketing methods, most fruits and vegetables are graded according to government standards. Grade A rates a top price and there is usually a market for all we can grow in this classification. The second grade, which brings a substantially lower price, has a full demand some years but only a portion is sold in time of great plenty. The third grade is left unharvested for the most part, or is used for feeding livestock or for fuel. The price, if obtainable, is very low. For example, if U. S. No. 1 potatoes are \$24 a ton, No. 2 \$16 a ton, the culls which could be sold to starch or other manufacturers would bring only \$6 or \$7. With growing expenses and high transportation costs out of proportion to their value, culls cannot be shipped any distance to market at a profit to the grower.

**We Must Grow Food More Economically.**—In the early days of marketing, we found it possible to get an abundance of supplies near our markets. Our manufacturing and distributing systems were built up in the centers of big cities but as they grew, it became more and more necessary to go further afield for our raw products. To the increased cost of distribution and transportation was added the necessity of providing refrigeration and other methods of preserving food. Now the country has grown so big and the problem of food distribution become so complex that we must get back to first principles. We must find a way to grow our

food where it can be done most economically and then find the cheapest way of getting it to market. When we have accomplished that, we will be able to provide the low income group with good food, easy to get, and the ability to get more of it for a dollar.

Roughly, the consumer's food dollar is spent as follows: about 18% to the farmer for growing the material; 23% to the manufacturer for processing, and 59% for distribution. Actual savings to the farmer cannot amount to a great deal. Also the cost of manufacture cannot be changed very much. The 59¢ for distribution is the one point where dehydration can save money.

**Dehydration Reduces Marketing Costs.**—Feeding 130 million people is a colossal task. It cannot be done without large scale operations in many sections of the country. Small farms, garden patches and the like cannot supply all our needs. We must count on big scale farming in localities far distant from city markets for the main bulk of what we eat. New York City, for example, goes to Northern Maine, to Wisconsin, to Florida, to Texas and to California for its foods. Culls and seconds in their natural form offer no profit when shipped from such long range points of growth. Nevertheless, they are needed if food is to be plentiful for the lowest income families. They can be made available only by some method of processing which reduces the marketing costs such as dehydration.

A study of ways and means to preserve surpluses and to get them to market is not at all a new idea. Most of the common methods of preserving foods in use today have been devised very largely with this thought in mind. It first became apparent that our system of distribution was outmoded when, in 1910, our cities began to burst through their original boundaries over wide urban areas, growing larger and larger every year. The trend of our population to the big cities and the great industrial centers was away from the farm and the small town where distribution problems were simple.

**Preserving Foods Without Adding on Extra Costs.**—While we have recognized the increasing burden of feeding our great metropolitan areas with the wide variety of foods which consumers expect, the only changes have been roughly those which sped up our operations: bigger and broader highways, fast freight, refrigerator cars, tank cars for the transportation of milk, 36-hour truck service from Florida to New York, improved packaging machinery,

manufacturing equipment of all sorts, establishment of great supply centers, storage warehouses and intermediate processing plants. But better methods of preservation such as packaging, canning and freezing only met the problem part way. While they preserved a great deal more food, they did so at an ever increasing cost. Not one went to the bottom of the problem to provide a means of preserving and transporting foods more cheaply. Dehydration, if it can be perfected to the point we believe possible, is the only method which will solve our difficulties.

**Mobile Units in Growing Areas.**—A dehydrating plant is small, can be made in mobile form or can be erected close to the growing area. This type of unit can be moved from place to place to take advantage of different crop seasons. The investment is small. Thousands of plants, located in sections where surpluses normally are found, could preserve the food in a form which would permit storage over long periods of time. When a sufficient reserve is stored away to meet every possible contingency, surpluses can be forgotten but not before.

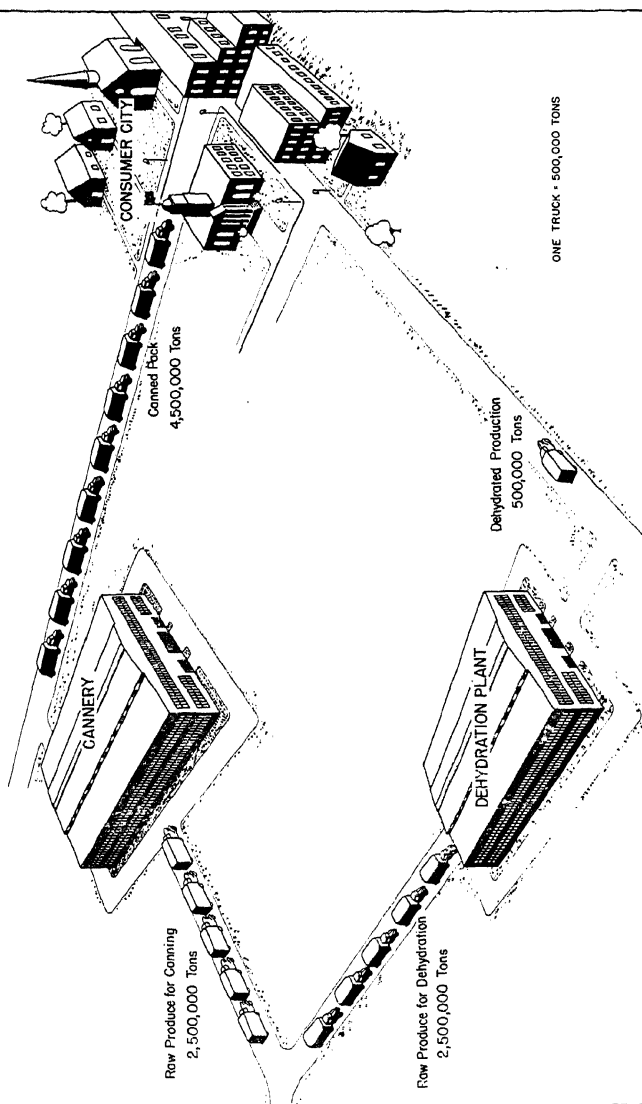
The method which we are advocating is similar to the farmer's use of the threshing machine today. When a small crop is ready, the grower calls for the local thresher who drives his equipment to the farm and threshes the wheat. The farmer, then, either stores it in his granary, moves it to a grain elevator, or disposes of it on the open market. The method cannot be adopted with canneries and would be too expensive for freezing plants.

To these mobile units could be added thousands of community plants permanently located and operated by cooperatives or by small companies. They would be designed to handle normal surpluses found within a short radius. To complete the cycle, there would be the large dehydrating plants, corresponding to the modern canneries or freezing plants. These would handle foods in the large agricultural centers.

As an example of the change this would create in distribution, let us take one or two areas. In the Brownsville district in southern Texas there are hundreds of thousands of acres of rich irrigated lands, one of the garden spots of America. At the present time, crops are sold largely in the green state to far distant markets such as Chicago and New York. Picked at a point in their maturity when they can be transported most safely, the products ripen at the market place and bring extremely high prices as off season items,



WEIGHT RELATIONSHIP BETWEEN RAW, CANNED, AND DEHYDRATED PRODUCTION OF CORN, PEAS,  
STRING BEANS, TOMATOES, LIMAS, PUMPKIN, AND CABBAGE  
BASED ON QUANTITY OF RAW PRODUCE CANNED IN 1941



even five to ten times the price to the grower of the same vegetables harvested in northern states during the normal season.

**An Example in Point.**—The cost of shipping a trainload of 80 cars of cabbage to Chicago from this area is about \$24,000. The cost of shipping the same amount of cabbage in dehydrated form would be \$2700, a net savings of \$21,300 in transportation alone by removing the water.

Very little canning or freezing is done here because it is hundreds of miles from its nearest market and thousands of miles from its principal ones, making it impossible to compete with goods processed in more centrally located areas. Even the cost of transportation is more than the cabbage, for example, will bring at its destination if the shipment should happen to reach an over-supplied market. If the food were dehydrated at the point of growth, however, the great advantages of low cost fuel, ideal labor conditions and generally cheap large scale operations would enable the manufacturer to compete with similar products prepared anywhere in America.

Then there is California, a state which grows approximately one-fifth of all the fruits and vegetables consumed in the United States. Because of ideal climatic conditions, two crops a year are available just as they are in Texas. Much of California's food is shipped thousands of miles to all parts of the country. Here again are the same natural advantages for dehydration that are found in Texas.

If we were to look at the problem from another angle, the situation becomes even clearer. Let us take milk. Today, milk is produced in every state in the Union, but, for our purposes, we need only consider the problem of distribution as it applies to great cities such as New York.

**Possibilities in Milk Dehydration.**—Milk for the metropolitan area is brought from many points of the country, even as far distant as Wisconsin. It must be handled with the greatest care and under the most exacting conditions every step of the way. All these precautions cost money. The portion of the milk which is produced near New York City comes from many hundreds of dairies small and large. The problem of feeding the dairy herd is a colossal one. This cost alone amounts to a high percentage of the total price of the milk and the availability of feed often

determines the number of cows a farmer can keep. To obtain milk at a lower cost, the big dairy companies have gone as far afield as is economically possible under present methods.

But why not change the method completely? Instead of bringing feed to the cattle, take the cattle to the feed, produce milk in the big central western states, dehydrate it at the point of feed production and deliver it to the urban areas. The transportation cost would be one-tenth and the grocery store channels could be used instead of the expensive milk truck which we are accustomed to see at our back door every morning.

**Vitamin C in Milk.**—In this way, the necessary pasteurization of milk which destroys much of the vitamin content, could be avoided and a more valuable food delivered to the consumer. It has been said that there is more vitamin C lost by our present methods of preserving milk than the nation produces from the entire citrus crop. Dehydration does not destroy vitamin C in milk.

Another product presents pretty much the same story. Potatoes are grown in most states but the greatest production is in Idaho and the northeastern section of Maine, two widely separated points each far distant from its principal markets. Every year hundreds of trainloads are shipped from these areas to all parts of the United States. On the basis of eight to one reduction through dehydration, the saving in transportation would be greater than all the profits of most of the people engaged in growing and distributing potatoes throughout the country.

**A Low New Capital Investment.**—To add to the list of advantages, it should be noted that dehydration makes use of the normal facilities of food distribution. The present canning machinery can be used in the preparation of the raw materials. Only ordinary storage warehouses are needed. Standard freight cars without refrigeration are adequate. The regular type of truck and equipment found in the retail stores are sufficient. Hence, dehydration offers the food industry an opportunity to change over in part or to participate with the lowest possible new capital investment.

Further, it should be noted that the classification of fresh foods into three grades is not always because of quality or nutritive values. More often it is due to size, shape or general appearance. Where the seconds and culls are classified because of these characteristics, and not because of lower nutritive values, they can be dehydrated

SHIPPING SPACE REQUIRED FOR COMPRESSED SPRAY DRIED EGGS COMPARED TO SPACE FOR SPRAY DRIED EGGS, FROZEN EGGS, AND SHELL EGGS



1 shipload of Compressed Spray Dried Eggs is equal to



2 shiploads of Spray Dried Eggs in 14 pound packages

or



2.52 shiploads of Spray Dried Eggs in 175 pound barrels

or



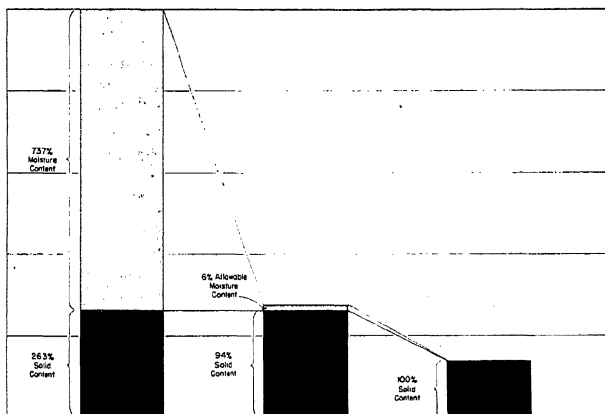
4.74 shiploads of Frozen Eggs in 30 pound cans

or



11.46 shiploads of Shell Eggs in 30 dozen cases

PERCENTAGE REDUCTION OF VOLUME OF EGG FROM WHOLE SHELL EGG TO SPRAY DRIED EGG AND TO COMPRESSED SPRAY DRIED EGG



successfully and as good foods produced as with grade A raw material. This is not possible to the same extent with other methods of preservation.

To sum up the situation briefly, dehydration can revolutionize and cheapen distribution by lowering transportation costs, by eliminating expensive handling and storage equipment and the cost of such operations. By transportation, ship, rail, truck and cargo plane are included. Various other savings will not be discussed here but it might be well to mention a few of them. First: the purchase of all grades of fruits and vegetables from the farmer would, it is estimated, lower the cost of raw materials to the dehydrator by five cents on the dollar at a minimum. Second: the use of less expensive types of packaging material would save 25% in packaging costs. Third: the smaller capital investment required by the average plant plus the ability to spread the overhead over a longer period of operations than is practicable with the average cannery would reduce overhead cost.

**Comparison of Canned and Dehydrated Soup Costs.**—To emphasize what the difference in transportation can mean, the cost of shipping from New York to Chicago a case of 48 cans of soup is 51¢ per hundredweight. The corresponding rate for dehydrated food is 92¢ per hundredweight and the equivalent food value eight times that of the canned soup. Thus, transportation of the latter costs over four times as much as the dried product. Reduced to the cost per serving, this means that the consumer of canned soups pays one-fifth of a cent for rail transportation while the consumer of dehydrated soups is charged only one-twentieth of a cent. This difference is far more than the canner's average profit. The dehydrator, therefore, can pass on this gain to the housewife in the form of lower prices or more food for the dollar and still make a normal profit. As a proof of this condition, dehydrated soups are sold usually in retail stores at prices equivalent to canned but in containers offering from 20% to 25% more servings than the can of equivalent price.

Many statistics have been prepared purporting to show how much food is consumed by the average American family. It is variously estimated but concensus of opinion seems to indicate that with today's prices, a family of four will spend \$16.20 per week, approximately \$2.50 going for canned and packaged goods. While dehydration could effect some savings in the other general classifications such as beverages, seasonings, desserts, dairy products and

vegetables, it is the sum spent for canned and packaged foods that would be most directly influenced. First, there would be a saving in cost; and second, because of lower price, there would be an increase in the amount purchased, resulting in more food for the same dollar.

**Possibilities in Dehydrated Soups.**—To illustrate—the fact that \$20,000,000 worth of dehydrated soups were sold in 1942 without reducing the volume of canned soup consumed. The lower price enabled the housewife to buy more without cutting into her purchases of other foods. In this particular field, it might be added, the average American family buys about three cans per week, presumably serving soup three times. Comparing this with the 12 or 15 weekly servings customary in some foreign countries, a fair picture is given of how far the dehydrated soup field alone can grow.



A modern dehydrated soup package made of laminated glassine with a heat-sealed closure. (Courtesy Thomas M. Royal Co.)



This heat-sealed soup bag is of triplex lamofim. (Courtesy Benj. C. Betner Co.)

## CHAPTER IV

# THE POST-WAR OPPORTUNITY IN DEHYDRATION

**Future Opportunities Are Post-War.**—At this writing, the winter of 1943, it is apparent that the opportunities for those not already actively engaged in the dehydration industry are strictly of the post-war variety. As we have stated previously, production has grown from practically nothing to 400 million pounds in the fruit and vegetable division and into an overall capacity of more than 1,800 million pounds in 700 plants. (This figure does not include 1,000 very small milk plants scattered all over the country.) This indicates that we are approaching rapidly the immediate saturation point unless the war is greatly prolonged. While no one is able to say definitely when the conflict will end in Europe or with the Japanese, the best guess at this time seems to be that the largest government orders for strictly military purposes already have been placed. Straws in the wind are releases from restrictive freeze orders of various products, such as carrots and sweet potatoes, previously limited in supply but now evidently abundant as far as the government is concerned.

Many of the 700 plants mentioned were not yet in operation in August 1943, but all of them are expected to be by December 1943. When new plants first get under way, there is a period of delay in reaching maximum production running anywhere from three months to a year so that capacity cannot be expected from all the plants now in prospect before the early part of 1944. At that time, it appears that the greatest demand from the government for war purposes will have been passed.

**Dehydration as a Relief Business.**—However, if relief feeding is considered a strictly government business, the near future of dehydration looks very good, especially if such world-wide feeding

programs as mentioned in our introductory chapter actually are carried out to any extent. Figures running as high as 500 million persons to be fed, at least in part, have been estimated by such experts as Herbert Hoover and Herbert Lehman.

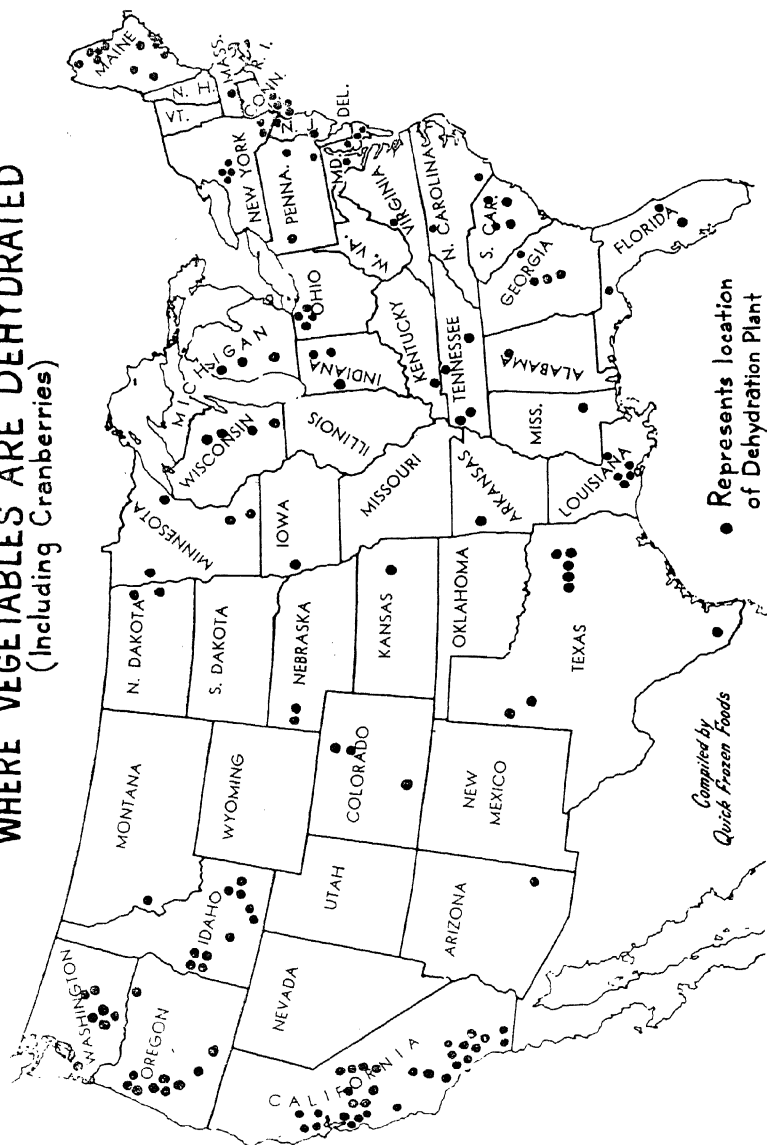
Whether or not the food purchased is in large part dehydrated will depend on a number of circumstances, many of which are difficult to foretell. Many critics proclaim the probability that the great saving in space and weight will be of less importance than it has been under war conditions. It is true that we are building the greatest merchant fleet the world has ever seen. It is also true that after the last world war, emergency ships could be bought for a dime a dozen. Hundreds were broken up for scrap. While the type of ship being built today is far superior to the vessel produced in 1917, it is still far from certain that we will be lacking shipping space a few months after the war. That does not mean, however, that it will not be important to make use of all the savings involved such as lower freight rates, fewer man-hours of handling, and so forth. While the great urge to buy dehydrated foods, because of the two features mentioned above, may be absent, the tremendous cost of the program upon which we may be launched should make it just as important to use dehydrated foods to save every possible dollar.

**There Will Be Competition from Other Countries.**—It should be remembered, too, that while we may be involved in a desperate campaign to increase all types and kinds of food supplies, we already have aided other countries immeasurably in improving their production. After the war, this is going to mean keener competition. We have spread the gospel of dehydration in every country on the globe. Equipment has been sent to India, North and South Africa, Australia and to most of the countries of South America, particularly to Brazil and the Argentine. Canada has quadrupled its dehydration industry. Politics, local and international, will enter into the situation. Pressure groups representing growers of crops of normal surplus will be insistent that their products be “dumped” on the various countries to maintain higher prices here. All of which indicates lower cost dehydrated foods should be more competitive than other processed types.

**A Potential 500 Million to Feed.**—While the above conditions might have their dark interpretation, offsetting and perhaps more than offsetting them is the fact that the dehydration industry's



# WHERE VEGETABLES ARE DEHYDRATED (Including Cranberries)



dollar volume of business, as indicated by current orders, is only about 20% less than the canning industry claims and three times as much as the frozen food industry. The dehydrated food has been purchased principally to feed our armed forces of 10 million men, and, to a certain extent, 48 million more people in Great Britain, 180 million in Russia, and a few million in countries bordering the Mediterranean. The total makes a respectable comparison with the 500 million the United States may be expected to feed in part after the war. However, the comparison is not correct. The actual amount of food shipped to Russia is only a fraction of what is consumed in that country and what is sent to England is a small percentage of their total food supply. If the figure of 500 million is approximately correct, it might be compared with our present feeding of 50 million.

Planning committees of our government consulting with similar United Nations groups indicate that the amount of dried and dehydrated foods needed might be a five-fold increase or nearly ten billion pounds. This total does not seem at all out of line on the per capita basis of dried foods consumed in 1943-1944.

To plan for such a program, we must provide now for five times as many plants as at present; or a smaller number of larger plants; or, if mobile units are developed, a great many times this number located in every community where surpluses are available. Even if we increased our production, we would still have less than half the number of plants of all types said to be in use today by the Axis countries.

A heartening side of the picture is the fact that in bringing dehydrated foods to the devastated countries, we are distributing a kind of food which is largely familiar. It should not be half as difficult to sell dehydrated foods to a European as it is to an American today. Considering that Europeans may not have any substantial supply of food for the first six months after the war except from this country, there should be no resistance. The market is there for the taking.

**But the American Market Must Be Developed.**—Interesting as the prospect may be for great expansion immediately after the war, we still believe that anyone who wishes to enter the field at this time should consider doing so strictly on the long term prospect of building a broad consumer market. The devastated countries will be rehabilitated some day. It may take two years, it

may take ten, but if we provide the inhabitants with equipment and restock their farms with animals to replace those killed off by the Axis, they will soon make a start towards raising their own crops. It is the first principle of self-preservation: to grow as much of your own food as possible. Also, the burden of taxes, high as they are and will be for many years, will be great on corporations. It will be difficult for new dehydrators to make money and to build up reserves strictly from government sales which are rightly at the lowest possible cost commensurate with a limited return to the manufacturer. There is the ever present danger that the government may change its mind without much advance notice. The colossal task of feeding the world may be one our country will not wish to continue indefinitely, even in part.

**Building Local Consumer Demand Eventually Is Necessary.**—The real future for those who enter dehydration is in building a local consumer demand for their product. In a growing industry of this character it is possible to do this within a relatively short time. The manufacturer has a potent weapon: quality food at lower prices. He has the edge on many competitors from the time he starts to produce good food at the right price. We should consider how he may get started in this field on the basis of the long time outlook.

Present vegetable and fruit dehydration plants are located in 39 states but the majority are found on the west coast, principally in California, and on the eastern seaboard in Maine, New York and New Jersey. When this section of the food industry suffered a severe slump after World War I, the only companies remaining in the business, with one or two exceptions, were in California. Consequently, it is natural to have the state take the lead in the revival in 1939. There is no state in the Union which provides more abundant crops, a wider variety, or more ideal climatic and operating conditions in normal times.

**Some Facts About Present Dehydrators.**—Egg and milk dryers are found in widely scattered locations but, for the most part, they are in the Middle West with a few in Texas and on both coasts. The meat dehydrators are the large packers and production is in their middle western plants.

Of the original small group of companies dehydrating fruits and vegetables, one uses the vacuum method, one the drum, and all the others the tunnel or cabinet. The corporation using the vacuum

process produces principally fruits; the drum dryer is used for high acid fruits and vegetables; while the tunnel and tray companies, with one or two exceptions, make a wide variety of both fruits and vegetables. One company makes as many as 58 different products. Three have specialized in one or two products, one producing potatoes, two others onions and garlic. A number of the original companies operate several plants each. None of them were very large or expensively built. The average plant had a capacity of 6,000 to 10,000 pounds of finished dehydrated material per day, depending upon the product. The average cost of each plant, including equipment, was between \$100,000 and \$250,000, depending on the type of construction and the amount of storage and warehouse space available. Construction, for the most part, was very simple, corresponding in general to the average type of structure used in the canning field. Total resources of the original group were in each case comparatively small. Their combined business did not exceed 15 or 20 million pounds before the war.

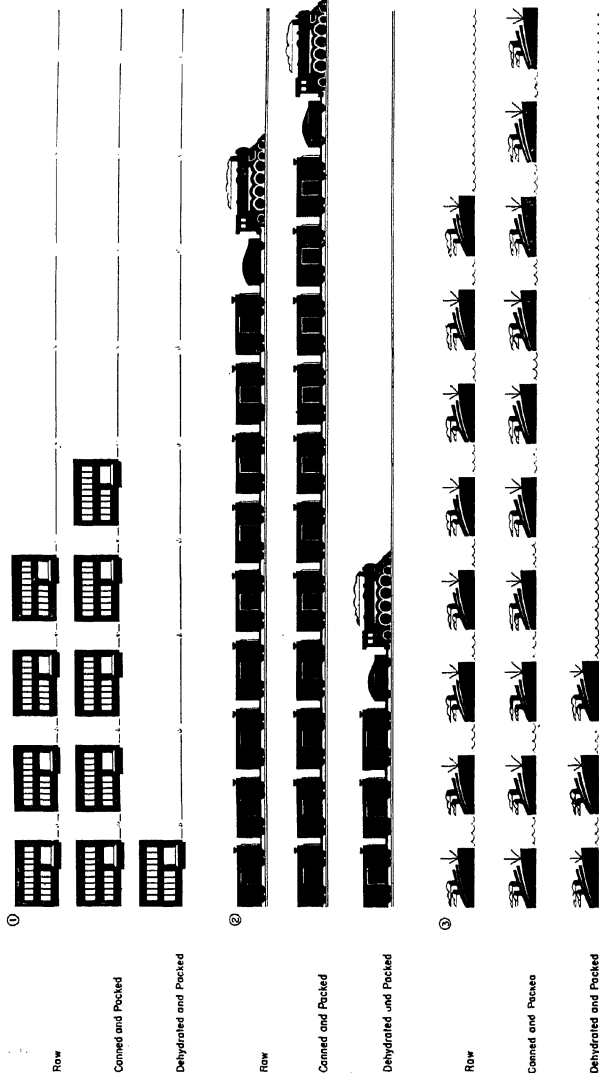
When the expansion in milk and egg drying took place, many companies found it possible to get started on as little as \$25,000 to \$50,000. The buildings were leased or equipment was installed in existing plants and the dehydration work carried on as a division of an already actively operating food company.

**Types of Ownership Now Operating.**—A large number of the 250 new vegetable dehydrating plants are owned by corporations which have been in some division of the food business for a period of years. Such companies have either installed equipment in their canneries or have erected small additions, using present machinery for processing and packaging.

A large number of conversions of old plants have taken place. While a few have been successful, generally they do not represent any great saving as the equipment is usually less efficient and more costly to operate than a modern, specially designed plant. In a number of instances, entirely new companies have been organized for the special purpose of producing food for the government and with the intention of the owner of staying in business only if dehydration proves to be a well established industry when the war ends. At least six of these are said to represent an investment of between \$500,000 and \$700,000, each with capacities ranging from 40,000 to 70,000 pounds of finished product a day. The owners of one claim to have invested \$1,500,000 and have a rated daily capacity of 150,000 pounds.

# COMPARISON OF SPACE REQUIRED FOR STORAGE AND TRANSPORTATION OF RAW, CANNED AND DEHYDRATED BEETS, CARROTS, SWEET POTATOES AND WHITE POTATOES

BASED ON SIZE OF 1941 CANNED PACK OF THESE VEGETABLES



① Warehouse volume equals 2,000,000 cu ft each

② Each figure equals 300 box cars. Box car volume equals 3,000 cu ft each.

③ Ship volume equals 1,000,000 cu ft each

It should be remembered that only fruit, vegetable, milk and egg drying companies are being discussed. There are a large number of other drying plants capable of producing foods. These are, for the most part, engaged to capacity in making standard products such as starch, flour, chemicals, and so on.

**Considerations When Going into Dehydration.**—The first important point in deciding whether or not to enter the dehydration field is to determine which products offer the greatest advantages in the size of market and in possible profits. Then it is necessary to find the proper plant location for the most efficient and profitable operating conditions.

When the government's demand for dehydrated foods became generally known, prospective manufacturers found that the greatest orders were for Irish or white potatoes and soups. As a result, a high percentage of the early companies processed potatoes. At present, the capacity for producing white potatoes is believed to equal the demand and probably is substantially ahead of any immediate post-war consumer market. A commercial market of nearly 3 million pounds had been developed before the war. However, the company most responsible for this development, turned over its entire capacity to the government, making a supply immediately available of this acceptable product. Therefore, although it will be necessary to rebuild the consumer market, the long range potentialities of this field exceed those of any other single vegetable.

There is a wide difference in the quality of dehydrated potatoes. They are not as easy to produce as might seem to be the case. Undoubtedly, a number of companies of the high cost or marginal type will find it difficult if not impossible to meet competitive conditions. If new companies are properly located at the source of the raw material supply, and follow the best standards of operation, they should have a product which can be priced competitively and still afford them a fair operating profit.

**Operations of Soup Dehydrators.**—Filling the demand for soups was handled in an entirely different way. A prominent cereal manufacturer, long interested in dehydration, turned over a substantial portion of his plant to the production of pea and bean soups for which his equipment was well adapted. Several others produced a limited amount of ready mixed soups for sale directly to the government. However, most of the 138 companies which entered

the field within a period of a little more than a year, bought their ingredients from established dehydrators and mixed them in dry form according to formulas prepared by the government. Thus, the vegetable dehydrators had the additional problem of producing the chief elements of soup. These are milk, starch, onions, sugar, salt, spices, plus the base vegetable flavor desired. A large number of companies brought out noodle soups, in some cases manufacturing their own noodles but generally buying them from established manufacturers.

**Easiest Products to Dehydrate.**—Of the other principal products sold to the government, new companies found carrots, beets, cabbage, turnips and sweet potatoes the easiest to process. The demand, however, while substantially above pre-war requirements, was considerably below that for potatoes. By the middle of 1943, producers of carrots and sweet potatoes had caught up with the market and were making between 15% and 25% more than was required by government agencies. The commercial demand for carrots has increased steadily as they are used as an ingredient for vegetable and other soups.

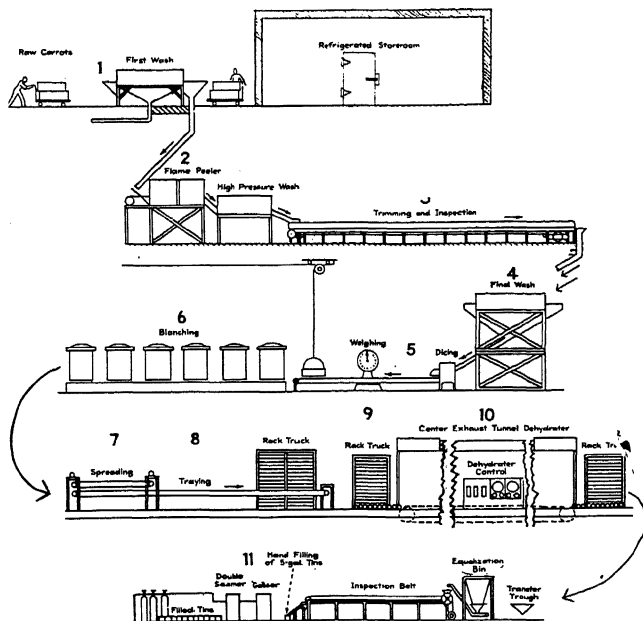
Tomatoes, onions, and garlic always have been considered more difficult to dehydrate. Special care is needed to produce good results and the equipment, in the case of tomatoes, is very much more expensive than that commonly used for other vegetables.

**Fruits Bought by the Government.**—The government demand for fruits has been limited to apples and cranberries. While there were only two apple dehydrating companies at the beginning of the war, there were a large number which dried apples. Some of these became dehydrators. By 1943 the available supply exceeded government needs by 50%. There is, however, a well developed commercial market for both dried and dehydrated apples with the latter destined to cut into the dried field more and more as their high quality becomes better known.

Companies manufacturing cranberries are limited to two or three. This is a difficult product to dehydrate properly but the result can be one of the best in terms of quality. A high percentage of the entire cranberry crop is dehydrated annually, principally for the government.

**Caution on Eggs and Milk.**—The amount already being produced in the egg and milk drying sections of the industry seems

## Dehydration of Vegetables ... Carrots



FLOW CHART FOR THE DEHYDRATION OF CARROTS

(1) Diagram shows raw carrots being put into the first wash. (2) Carrots drop into flame peeler and are then conveyed through high pressure wash, (3) and onto the trimming and inspection belt. (4) The product then drops into the final wash, through the dicing machine, and after being weighed, (5) goes through the blanchers, (6). (7) After spreading and traying, (8) the carrots are loaded onto the rack truck. (9) The truck goes into the tunnel dehydrator, (10) and after emerging goes into the transfer trough. The equalization bin follows after which products go into the inspection belt and are then, (11) hand filled into five gallon tins. (Courtesy Food Industries.)



## DEHYDRATION, ITS POST-WAR FUTURE

so high in comparison with any future commercial market that a need for caution in entering the field is indicated. While new uses may present opportunities for wide development, they will take time. Considerable readjustment may be necessary unless the slack is taken up by feeding the devastated countries..

Practically all other products are dehydrated today in such small volume as to indicate unlimited opportunity for future expansion. The market for any dehydrated product which has been proved acceptable commercially could be quickly and greatly enlarged except possibly in the case of eggs and milk. New companies could be established to produce any of them but early competition in white potatoes, sweet potatoes, carrots and apples suggests that the plants be so placed as to permit the dehydration of more than one product. In choosing the location, the emphasis should be on the availability of other products.

**The Government's Stake in Dehydration.**—Before getting down to the problem of where to locate and the type of factory to build, there are a few general observations regarding plants and equipment which might be mentioned. In the first place, it should be understood that the present industry has been sponsored very largely by the government. Much money has been loaned for the erection and equipment of plants, although very little went for bricks and mortar, most of it going into equipment. In addition, the government has loaned the great majority of the companies large sums for working capital through what is known as the Regulation V Loan type of operation, and similar financing plans. Consequently, the government has controlled within limits the location of plants, type of equipment purchased, and choice of foods to be processed. Under the stress of necessity, it has had to put on pressure to get production started quickly. Therefore, it was not always possible to select the best type of equipment known to the industry, or to insist on the highest standards. The marginal manufacturer had to be accepted in order to get the volume. There were not enough trained dehydrators in the country to expect that all the food needed could be produced under the supervision of highly skilled technicians.

**War Plants Not Always Most Efficient.**—This has led to the establishment of many plants in relatively poor locations for commercial work. It has also resulted in building plants with second grade equipment. Post-war obsolescence is bound to be an important factor to be considered by present companies. Many of them will

find when war restrictions are removed that there are new and improved types of equipment available which can turn out better and cheaper foods than those now in use. Corporations desiring to enter the industry should not duplicate existing facilities without a close study of new ideas and new inventions.

While present structures and existing equipment have proved adequate for the emergency, many of them should be shut down and modern, sanitary plants erected in their place. No company should assume that any type of building with a roof and a floor is good enough for dehydrating. On the contrary, the finest plant in the country is none too good when the first principle of good foods is accepted as sanitation and cleanliness to a high degree in every operation. Many plants are bothered greatly by insect infestation, mold, and other bacterial growths. Such conditions cannot be removed completely from some plants as they exist today.

A survey of the best plants in the country, however, will prove that they are as modern and up-to-date in every way as the best canning plants, with perfect drainage, washable walls, floors and partitions; air-conditioned packaging and operating rooms; humidity control and provided with every known means of complete protection for the product from receiving to shipping. Such buildings cost much more than others initially but they pay for themselves in quality products which will win and hold a market at the best prices.

Through the widespread interest which has been created in dehydrated foods in the last three years, many food technicians, chemists, and other scientists have made a careful study of these problems and are now available for consultation or for employment by new companies.

It can be said safely that a good organization is not only necessary but worth much more than the best equipment or the best designed building. However, due to the perishability of the materials, even the best organization cannot produce good results without the necessary tools with which to work.

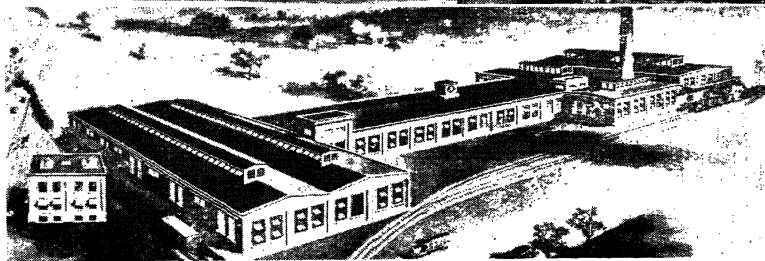
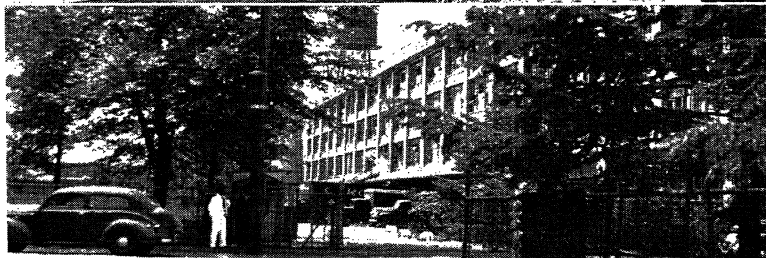
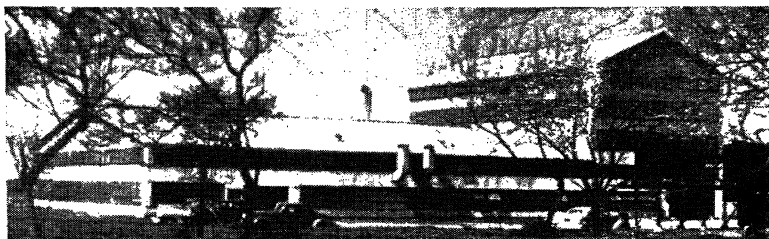
**Soy Beans, Pea Powders, Etc.**—If a company intends to manufacture and, also, to distribute, it is well to make special note that certain types of dried foods, closely resembling dehydrated foods, are becoming prominent in the soup field. Such products include soy beans, pea powders and bean powders. Often these can be purchased freely on the open market and used as a base for

soups without the necessity on the part of the distributor of providing additional equipment or overhead except for merchandising and selling costs. Because the suppliers sell large quantities at low cost, it is necessary to remember that only one profit and that a very reasonable one per pound will be obtained in the distribution of these products. Emphasis by new distributors should be placed upon the higher valued type of soups and other products for which there is a good market. These, when combined with lower cost dry mixed varieties will help greatly to establish a new business on a profitable basis.

**Conditions Immediately After the War.**—It is predicted that during the transition from war to post-war, part commercial and part relief business, there will be a number of months during which substantial amounts of dehydrated foods may be available without a market. This unstable condition probably will be due to two things. First, no sales organizations at this time are endeavoring to develop a market except for a few specialties such as soups, seasonings and desserts. The reason is that the government has frozen most of the vegetables which it is buying in large quantities. Hence, it does not pay a sales organization to build a market on these products. On the other hand, the government has authorized the erection of more plants than were necessary on the theory that some of them would not get into production for one reason or another, and therefore, to get the full amount needed, the licensing of a reserve number was advisable. Actually, more of these companies may get into full production than was expected leaving the market temporarily burdened with certain vegetables.

As soon as it is seen clearly that a continuous supply will be available, food distributors can be expected to add these products to their lines and to take up the slack in a short time. If the situation should develop as outlined above, it can be ignored as far as it might reflect on the permanent marketing of dehydrated foods. Manufacturers who have been concentrating on certain foods for the government can switch easily, if necessary, to other products more suitable for the commercial field.

# TYPICAL DEHYDRATION PLANTS



From top to bottom: (1) Universal Colloid Co., McAllen, Texas; (2) Fresh-Dry Co.; (3) Durkee Famous Foods, L.I.C., (4) Sardik Food Products Corp., Lockport, N. Y.

## CHAPTER V

### WHERE DEHYDRATION FITS IN

**An Industry Re-born of Emergency.**—The real development of the industry started with the declaration of war by Great Britain in September 1939. Up to that time even the temporary advantages of dehydration in such emergencies as now exist were scarcely thought of and those who mentioned them were given scant attention. Even the more persistent members of the industry were unable to get favorable consideration from commercial organizations. They turned their efforts to government officials who were persuaded to give a little time and thought to the subject as early as the spring of 1941. At that moment, Great Britain was manifesting great interest in the purchase of foods which would save weight and space in shipping. Shortly after we entered the war, the government announced plans for the development of the industry. This occurred before many of the big food corporations were ready to step into the picture.

As a result, the government has remained at the forefront. Practically everything which has been done to date has been approved first by the government's Committee on Dehydration. This fact should be kept in mind at all times in studying post-war possibilities since the government's point of view is quite different from that of independent industry. In the first place, the foods selected for processing had no relation to present commercial markets or future consumer demand. Secondly, the location of the plant, the types built and the equipment used were selected solely on the basis of immediate government need. Although much of the industry, as developed under government guidance, is sound and logical for participation in the post-war period, nevertheless, much will have to be undone and until it has reorientated itself, there may be uncertainty and confusion.

**Weaknesses in Government's Committee on Dehydration.**—The Committee on Dehydration issued a set of principles to

be used in determining the eligibility of corporations to participate in the expansion program. They were as follows:

1. Location of facilities with respect to war strategy.
2. Suitability of existing plants for expansion or conversion to vegetable dehydration work.
3. Availability of management and labor experienced in dehydration or other food processing work.
4. Possibility of converting existing food processing facilities to vegetable dehydration work with the least possible use of critical materials.
5. Availability of ample supplies of fresh vegetables.
6. Availability of labor for production and harvesting of vegetables.
7. Ability of plant operators to arrange financing of the expansion or conversion of existing facilities to vegetable dehydration work.
8. Geographical and climatic conditions affecting the suitability of vegetables for dehydration.
9. Availability of sufficient electric power.
10. Sufficient quantity of water free of impurities.
11. Adequate sewage disposal facilities.
12. Is building properly screened or located to avoid dust and objectionable odors?

These were followed later by a series of suggestions known as the War Production Board's six-point program for the elimination of waste in speeding up production. With the principles established, the Committee interviewed hundreds of applicants who sought permission to erect plants and to produce foods for the government. Several hundred were accepted and machinery was set in motion to put the successful companies into operation as quickly as possible.

**Restrictions Which Affected New War Plants.**—A glance at the principles set forth above indicates clearly why the selected companies are not necessarily properly established to do good commercial work. No. 1 states that the location of facilities will be determined according to war strategy. One of the restrictions under this clause was that no additional plants should be erected in California within 200 miles of the coast. While not followed strictly, it did keep a number of companies out of one of the finest

areas for dehydration in the country. Another restriction was that there should be more plants established in the Middle West. Although there are many fine sections for processing in this part of the country, it was not always easy to establish the companies on a good competitive basis to dehydrate the products selected for them.

No. 4 required that much material be used that would not be selected in peacetime, and also that plants be converted which were not suitable for the highest grade work.

No. 6 is another principle which was necessary at the time but the same labor conditions may not be present in peacetime as in wartime. Certain areas were barred because of poor labor conditions largely brought about by the influx of big war plants. Now these districts have no dehydrating plants although they might well have been chosen as superior locations in normal times.

After companies had been authorized and construction started, contracts were given to produce a very limited number of products. The first were selected by army and navy requirements. Later, a few more were added to meet the needs of the allied nations.

**Items Principally Purchased by the Government.**—The principal products purchased by the government are as follows:

apples	rutabagas
applesauce	soups:
baked beans	bean
beef	borscht
beets	chicken noodle
cabbage	pea
cranberries	soybean
currants	tomato
eggs	tomato soy
garlic	vegetable
milk	sweet potatoes
pork	tomato flakes
onions	tomato juice cocktail
potatoes	turnips

In addition, very small amounts of the following were purchased:

apricots	okra
bananas	prunes
celery	

A substantial amount of dry mix soups made under special government formulas was purchased also.

**Government Products Not Always Consumer Items.—**

A study of the list shows that the needs of the government differ from those of the housewife and the products she will be interested in buying. If this is true, the industry to date has been built up to produce foods for which there will be in most cases a limited demand after the war, or, certainly after the post-war period of feeding the devastated countries. Many of the companies devoting their production exclusively to government orders could change over to other products for the commercial market, at least, as far as their equipment is concerned. However, many of them are not properly located to do other foods. Products which we believe manufacturers will have a hard time selling after the war include:

bean soup	eggs
beets	milk
cabbage	rutabagas
carrots	sweet potatoes
cranberries	turnips

In contrast to the limited number of products purchased by the government, there are over 100 which have been produced successfully and sold in limited quantities.

**Products with the Best Prospects.**—Of the government's list, those which seem to have the best prospects should be divided into two classes: the first to include items of excellent commercial use which are not now over-produced for any reasonable future market; and the second, to be those which will have a good market but which now are being produced in such tremendous volume that it may take considerable time for the post-war demand to catch up. In the first group are:

apples	onions
garlic	tomato products

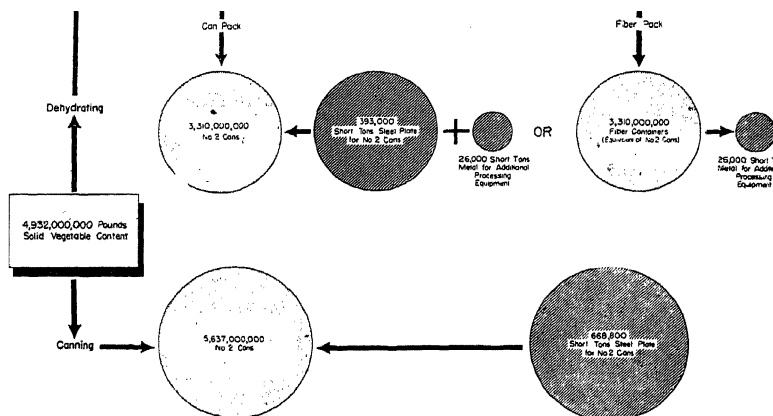
In the second group are white potatoes and soups. There is also a third group of government products which might be used commercially in large quantities for purposes other than those required by the Army and Navy. This includes sweet potato flour, cranberry juice cocktail, and, also, prunes and apricots for the bakery trade.

**Good Items Not Bought by the Government.**—Among the long list of successfully dehydrated specialties which do not fit into

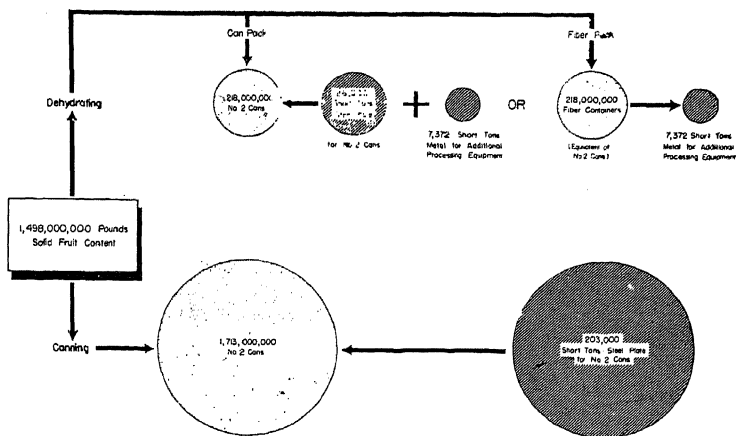


## DEHYDRATION, ITS POST-WAR FUTURE

VEGETABLES: COMPARISON BETWEEN REQUIREMENTS FOR METAL CONTAINERS FOR 1941 PACKS AND METALS WHICH WOULD BE REQUIRED FOR DEHYDRATING THE SAME QUANTITIES



FRUITS: COMPARISON BETWEEN REQUIREMENTS FOR METAL CONTAINERS FOR 1941 PACKS AND METALS WHICH WOULD BE REQUIRED FOR DEHYDRATING THE SAME QUANTITIES



the government program but which should find a ready commercial acceptance because they process well are, among the fruits:

apple butter	loganberries
blackberries	pineapple juice
blueberries	raspberries
grape juice	strawberries
ice cream mixes	

among the vegetables:

asparagus	pumpkin
corn	snap beans
lentils	spinach
lima beans	squash
peppers	

among the soups:

asparagus	mushroom
black bean	onion
corn	spinach
lentil	vichyssoise

such other specialties as:

apple pie mix	lemon pie mix
dessert powders	pumpkin pie mix

and such flour mixes as:

gingerbread mix  
pancake flour

In addition, there are many other dehydrated products which would have a ready sale, probably in small quantities, such as, among the seasonings:

chili  
mint  
parsley

and among the fruits:

cherries  
peaches  
pears

Most of the vegetables, with the exception of turnips, will be used as a base for soups. The principal market for fruits probably will be the jam and jelly manufacturers, the bakery trade, the makers of baby foods and ice cream mixes, with the further reservation that both fruits and vegetables may find a wide market in fruit and vegetable drinks.

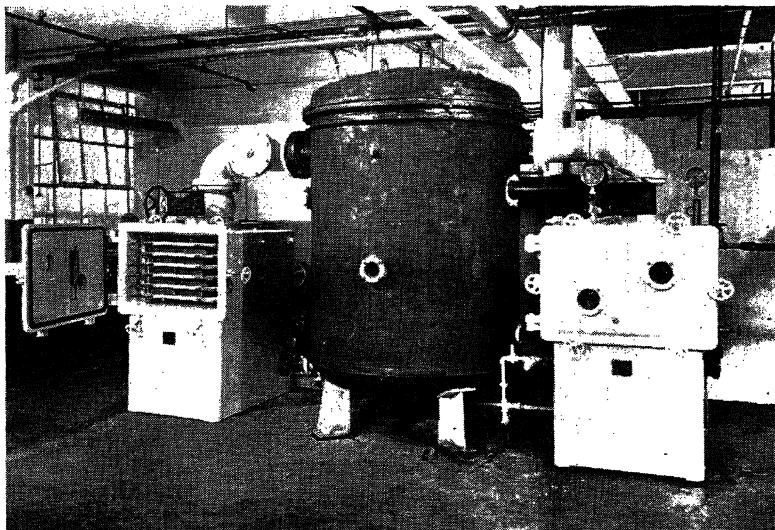
**The "Food Processor" of the Future.**—As a preface to remarks to follow, it should be made clear that if the trend in the food industry continues as has been the case in the last few years, eventually there will be no canners, freezers and dehydrators. Instead, there will be food processors. The new type of company will be prepared to process all types of food and will produce as much of each as the market will take. If the demand is for canned goods, the processor will place emphasis on this division of his operations. If it is for frozen foods, he will concentrate on that part of his production, and if it is for dehydrated foods, he also will be prepared. The development seems entirely logical when it is considered that dehydration is merely a process in which the housewife has no particular interest. All she wants is good food at the right price. Ability to offer a wider variety will aid the processor in increasing his volume. Ability to concentrate on one specialty or another will enable him to meet market trends with the least possible dislocation of his business.

Food manufacturers, who have developed their business to where it stretches from seed to consumer, should be the first to add dehydrating equipment to their present plants. They are in a strong position to follow sudden changes in popular demand. It will make no difference to them what they sell as long as they can obtain a reasonable profit—they will be able to produce quickly high quality foods no matter which way they process them. One of the best food packers in the United States has equipped himself in this manner.

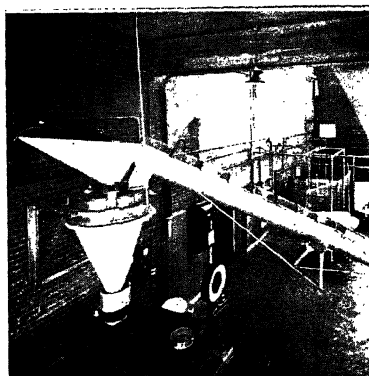
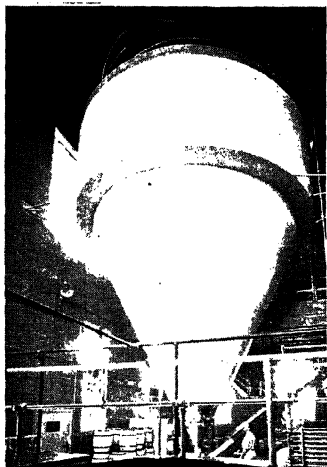
In many cases the food processor will also be a distributor and will find that dehydration offers an opportunity to place many new specialties upon the market. In addition, the use of dehydrated foods will reduce the cost of some of the vegetables which he is now selling.

**Industrial Uses of Dehydrated Foods.**—While the consumer may be the ultimate goal of most large distributors, it would seem that the biggest and easiest market for many dehydrators is the manufacturer and distributor. By manufacturer, it is meant to include the canner, the preserver and the packer of dried foods such as cereals, desserts, flour mixes, and bakery products. The industry, after studying the form and make-up of thousands of items already on the market, will find that dehydrated foods can replace many of the ingredients now going into established products.

It should be easier to sell a manufacturer on the advantages of



Vacuum dehydrators used in the sublimation method combining freezing with dehydration. (Courtesy F. J. Stokes Machine Company.)



The Gray-Jensen Spray Process for milk and eggs. At left, the spray drying chamber. At right, liquid eggs being pumped into the chamber under pressure of 4,000 to 4,500 pounds per square inch.

dehydrated foods than the consumer who often is influenced by high powered advertising and merchandising, cut prices, sales, and other common practices which offer difficult competition to the small dehydrator trying to establish his product. The manufacturer will be a large and steady buyer of quality, price and convenience. In the price can be figured the great savings in waste, freedom from spoilage, inexpensive storage of inventory and a regular supply of uniform products. The dehydrator can take much of the worry and risk off the hands of the jam and jelly manufacturer, for example. The availability of dehydrated fruits, which can be stored for a long period, if necessary, can cut down his seasonal worries about growing conditions, reduce price fluctuations and also his capital investment in perishable crops.

**Advantages to the Manufacturer Using Dehydrated Foods.**—As stated before, the fate of the industry depends upon its ability to offer quality foods for less money. We have shown that most of the saving will come from the 59¢ of the consumer's dollar which goes for transportation, handling and storage expenses. While this may be shown more realistically in direct sale to the consumer, we believe that the manufacturer, in substituting dehydrated ingredients for many of the fresh which he is now using, will find it possible to pass on substantial savings to the housewife who purchases brand goods. Thus, dehydration should have a two-fold effect. It will offer cheaper foods on its own account, such as the present widely marketed soups, or it will force down the price of many well known items now on the market.

**Position of Large Milk Producers.**—We have mentioned the advantages of dried milk and have indicated the tremendous possibilities of this food in revolutionizing distribution throughout the country. As many manufacturers of dried milk are also the biggest distributors of fresh, the final determination of whether or not there shall be widespread distribution of dried milk will depend on them. Naturally, the great economy in distribution of milk in this form is known to the big dairy companies. They know how much money could be saved if their products were placed on grocery shelves instead of being delivered daily by truck to the home. They know how much less it would cost to package and how much waste and spoilage would be avoided. On the other hand, the tremendous investment in plants and equipment, as they well know, would be rendered nearly worthless by a wholesale adoption of dried milk. The cost of new dehydrating equipment would be very little but the

obsolescence of old machinery would be difficult to write off without financially handicapping many of the companies. The change will have to come slowly. Several big producers, interested in dried milk, have discovered many new ways of using it as fillers and as substitutes for other materials. Their research departments undoubtedly will speed up their efforts to find additional uses for the enormous production capacity now available.

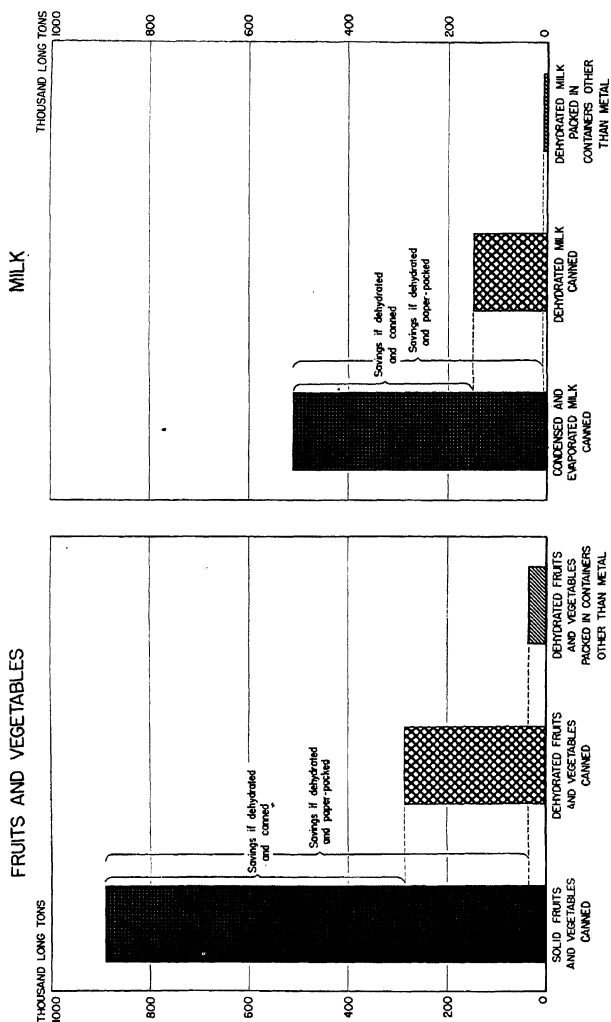
We have mentioned the potentialities of the dehydrated potato. One of the principal advantages is that there is little or no "kitchen resistance." Figuring the amount wasted in preparation, the cost of the dehydrated potato is less than half that of the fresh. Aside from the factor of price, the ease of handling such a bulky vegetable, the small amount of storage space necessary, its long life and the comparatively short time for preparation will be even more important.

**Possibilities in Tomatoes.**—There are interesting market angles to most of the products which we have listed as best for the commercial market. Take the case of tomatoes. Aside from the fact that they are one of the most popular vegetables, they are important as a base for a great many specialties in daily demand everywhere. Innumerable sauces, soups, seasonings, vegetable drinks and bakery products use anywhere from 5% to 95% tomato in their daily make-up. Many manufacturers, who have developed a large demand for their products, start their process from the whole tomato but a much larger percentage purchase tomato puree or paste from the canner. The concentrated form is used as the base material for their specialties.

At the present time there is no method for the dehydration of tomatoes in piece form which produces a high quality product. For the moment, the dehydrated tomato market will have little or no relation to use as a vegetable. However, the drying of the pure tomato in powder or flakes has been thoroughly demonstrated and widely sold for some years.

The method used for reducing the tomato to a powder produces a product designed to replace paste and puree of which between 6,500,000 and 7 million cases are sold each year. Fundamentally, there is no good reason for the manufacturer of paste or puree not to use dehydrated tomatoes, assuming that they are as good, and retain the nutritive values and vitamin content, especially vitamin C, equally well.

COMPARISON OF ESTIMATED QUANTITIES OF METAL REQUIRED FOR THE CANNING OF CERTAIN SOLID FRUITS AND VEGETABLES AND CONDENSED OR EVAPORATED MILK, OF DEHYDRATED PRODUCTS, AND FOR DEHYDRATED PRODUCTS PACKED IN CONTAINERS OTHER THAN METAL  
ON BASIS OF NO. 2 CANS FOR DEHYDRATED PRODUCTS



**Pastes and Purees.**—In the first place, it should be understood that comparatively little paste or puree is sold directly to the consumer. There is a small market for paste, particularly among the Italians, but there are few uses which could not be as well served by the dehydrated form. The great bulk is taken by the bakery trade, manufacturers, clubs, hotels and institutions. It is never served by itself but is a base for making innumerable dishes. In many cases, paste or puree is mixed with other liquids which could serve for the rehydration of the dried product as well as water.

About two-thirds of all the paste is manufactured in California, also a substantial proportion of the puree. Other large producing centers are Indiana, southern New Jersey and Maryland. The cost of shipping paste from California to the east coast where much of it is consumed is approximately 5¢ per net pound of solids. The cost of transporting the dehydrated product on an equivalent basis is 1¢ per pound. The comparison between purees and the powder or flake is over twice as bad. As the product has been a low profit filler for most canners, the freight from California to New York in normal times represents 20% of the sales price.

Aside from the direct saving in cost of delivery, there is the added convenience in handling and storing. Puree and paste are very uncertain products to handle and difficult to store and to transport without injury. Manufacturers who use them make it a point to carry as little as possible over to the next season in the way of inventory for fear of losses from swells and other forms of spoilage. Hermetically sealed cans of dehydrated tomato, packed in nitrogen and stored at room temperature or lower, will keep indefinitely.

Another great advantage is uniformity. Such important characteristics as acidity and sugar content can be adjusted accurately to meet any given formula. Furthermore, it can be made a purer product than the fresh paste and puree now being distributed because in the manufacture no seeds, skin or trimmings are used and the tomatoes are the regular field run whole tomatoes. In the case of the fresh, it is often made as a by-product out of second and third grade tomatoes.

The same advantages accrue to this as to other dehydrated foods, such as the ability to eliminate wide price fluctuations, to avoid the



dangers of short crops by carrying over a large inventory purchased at times of plenty and probably at low cost.

It is conceivable that a product of this sort may be carried on the housewife's shelves as a seasoning available at any time and as a base for many different home-made dishes.

It is interesting to note that one applicant for permission to erect a tomato plant proved that the entire cost of the factory, including equipment, could be paid for in full out of the savings realized on freight in one year's operation.

**The Mixed Vegetable Package.**—Another specialty which has been offered in test markets with some success and which would seem to have a bright future after the war, is the mixed vegetable package. Various combinations of three or four vegetables, sold in one container, offer the housewife a reasonably priced product that has many conveniences. If she desires to serve a mixed vegetable, she can avoid preparing several different ones. Also, she can use it when making vegetable salad, as a base for vegetable soup, or for vegetable stews. For those living in apartments, or who have limited kitchen space, or who serve small families of two or three persons, this is an ideal time and trouble saver. While it can be priced reasonably close to the average fresh vegetable market, it should be attractive without consideration of the money angle.

Other dehydrated vegetables which have special value and which should find greatly increased markets after the coming year are those which are not ordinarily canned or frozen, or which are much more conveniently used in powder or flakes. Among these are onions, parsley, garlic, mint and chili. Although widely used as seasonings before the war, they should have a broader market as the interest in dehydrated foods increases and better knowledge of quality is obtained by greater sales.

Onions are not easy to process properly which accounts for the fact that there are fewer good dehydrators of this product than in the case of several other vegetables. Onions are an important ingredient in many soups. Hence, the rapidly growing soup market should carry onions along with it. Their use by meat packers is also important. As a household product, the amount sold to date has hardly scratched the surface.

**The Market for Fruits.**—An interesting situation in the dehydrated fruit market gives rise to much speculation as to its ultimate

size. At the present time there are few dehydrated raspberries, strawberries, blackberries, or any of the other berries for that matter. There was no ready-made government market, therefore, no permissions were granted by the Dehydration Committee for establishment of new plants of this character.

In considering that most of the commercial berry crops mentioned are grown on both coasts, in Oregon and Washington in the West, Florida in the East, and in the extreme Northeast in the case of blueberries, one can readily understand the possibilities. Fruits are perishable, must reach market quickly and be consumed immediately or they have to be handled in cold storage from the time they are picked. This means great expense, not only in cold storage warehouses, but in refrigeration cars and other equipment.

Manufacturers of fountain syrups, ice creams, desserts, jams, jellies and marmalades are located in many sections of the country. Many of them have to transport their fresh fruit inventories from long distances. When received at the plant, they are processed frequently into various products which do not resemble the fresh at all. The juice is all that is desired. This being the case, the logical thing is to extract the juice at the point of growth to save the enormous expense of shipping 88% to 92% water. The housewife cannot tell the difference between jams made of dehydrated fruits and those made of fresh nor can she distinguish between the two kinds of dessert powder.

Citrus fruits offer the same problem as they are grown principally in Florida, Texas and California. They are more difficult to dehydrate and much work has yet to be done although great strides have been made in the right direction. Without doubt, a satisfactory dehydrated orange juice will be available some day. The advantages of dehydrated pineapple are even greater because of the longer distances from the West Indies and from Hawaii to the main markets. It is not claimed that dehydrated fruits can replace the fresh or canned in all cases but there are sufficient uses which offer the manufacturer a wide market.

**Eggs, Health Foods, Grapejuice.**—The case of eggs is peculiar in some respects. The small number of egg dryers with limited production prior to the present war did not provide much stimulus to the thinking of the big food processors and distributors. Now that there is a truly enormous productive capacity, producers have discovered that there are dozens of ways of increasing the use of

dehydrated eggs. Also they are much better than before the war. There are any number of instances in the bakery and in the dessert field where dried eggs can be used as well as storage. As soon as active sales organizations are permitted to function properly, their combined efforts are certain to open up large new outlets to replace the government's exclusive use of the product at the present time.

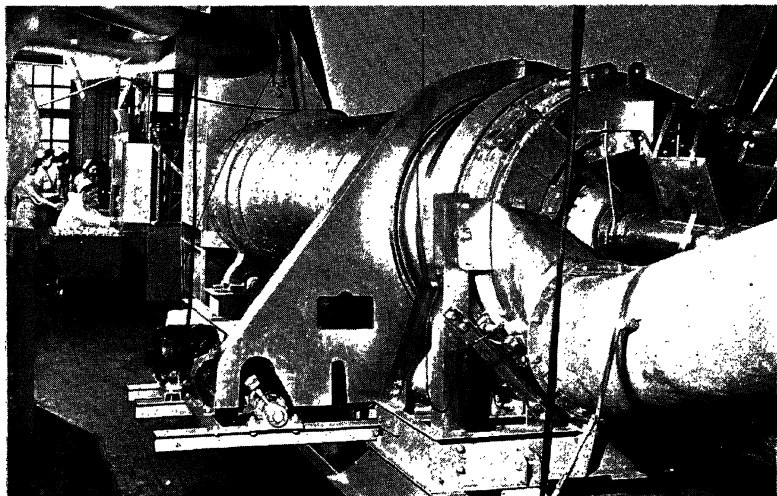
There is a special division of the food trade devoted entirely to health foods. This offers varied products, many of which have wider application than their name indicates, such as vegetable flours for making breads, pancakes, fritters, cookies, and many other bakery items. Many of the health foods get their sales appeal from their enriched vitamin content. With the widespread interest in vitamins, it should not be difficult for dehydrators as a group to foster greater use of specially prepared products which will be offered either as restored or enriched vitamin products.

In another case, grapejuice, efforts have been made from time to time to popularize its high food value and to get the public accustomed to drinking a bottle every day. For a while, dairy companies delivered fruit and vegetable drinks daily to the housewife along with the milk. The difficulty in this kind of distribution was in carrying the bulky bottles—the space was needed for the milk supply. The dehydration of fruit and vegetable drinks would simplify this and would add new profits to cover the high delivery cost of regular dairy products.

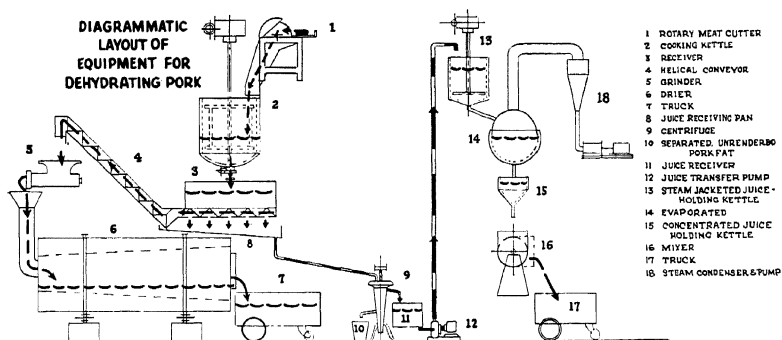
The ability to handle more items when they are dehydrated is what has made the industry so attractive to wagon jobbers, a type of distributor which has made tremendous headway, especially in the Middle West, in the past few years.

The average large super-market will handle as many as 3000 different items, of which 700 or 800 will constitute the bulk of its sales. An examination of all of the products found on the grocery shelves shows that over 400 of them are either in dried form or could be processed in this manner. It is not expected that the big field of the future will be dehydrating all the presently canned or frozen foods, but, as we have said, the number dried which already have found favor with the public and those which could be processed, indicate a wide market. Adding up the basic foods consumed in the United States today, it is found that nearly 90% could be affected in one way or another by the development of the industry.

## MEAT DEHYDRATION



Low temperature drying in a Swift & Co. rotary dryer. The product emerges in granular form, light nut-brown in color. (Rotary dryer, manufactured by Link Belt Co.)



**Dehydrating Meats.**—In the case of meats, the proportion dehydrated probably never will be very great although the actual poundage for special uses might be considerable. Hamburgers, meat loaves, and similar types of meat products are sold in enormous quantities. When they are served in places where refrigeration is difficult, the dehydrated form should have a good chance since it requires no special storage temperature. Their use in soups, stews and gravies also might be quite large in out-of-the-way districts where fresh meats are not readily obtainable.

**Dehydration Lacks Educational Program.**—There are several brakes on the development of the industry which should be released immediately after the war. The most serious is the complete lack of interest in the post-war market on the part of a large percentage of the dehydrators. They are too engrossed with the pressing problems of production and government orders of today to stop to look ahead. As a result, much of the dehydrated foods offered for sale have been thrown upon the market without an adequate advance educational program to acquaint the housewife about them, how they are to be used, where, when, and particularly, how to prepare properly. Educational work is part of everyday sales and will not be neglected when the manufacturer has to sell his product to survive. Then, too, where forward looking dehydrators have discovered how to improve their products, it has not been possible to include the new methods in present operations due to inability to obtain the necessary equipment.

A large percentage of the better manufacturers have grouped together in a national association to prepare for post-war distribution. The common efforts of these companies in research and development of work, as well as the study of how to popularize dehydrated foods, will go far to overcome the indifferent attitude of the great majority. The group has advocated continuously higher standards and has laid the groundwork for important improvements by furnishing the government experts, scientific and technical groups, universities and food foundations with material on the problems of the industry. With the aid of these technologists, at least, the more pressing problems will be receiving attention during the vital period prior to the main effort to establish a strong commercial market.

**Government Takes Practically All Now.**—Another handicap perhaps not generally realized is that practically all of the best products are taken by the government. Much that reaches the

public today, aside from those items which are completely free from government control, are rejected lots that failed to meet specifications. It is to be hoped that during the war, the consumer will have learned to distinguish between good and bad dehydrated foods as she does in the case of canned or frozen. Too frequently all dehydrated foods have been condemned because the first goods purchased were unsatisfactory and because of unfamiliarity with the product.

There is one fortunate factor which might turn out to be the making of dehydrated foods. Before the war is over, every member of our armed forces will have had an opportunity to eat one or more of them. The unprecedented opportunity for testing could not be obtained in normal times without spending millions of dollars. Further, by reason of the scarcity of foods which exists, consumers are trying everything once. There will be few households which will not have served one or more dehydrated soups and probably several other products. If the industry will take advantage of this abnormal condition, it will have had a remarkable groundwork laid for future sales without the attendant expense of demonstration, sampling, and merchandising development work which costs so much in the case of introducing a product.

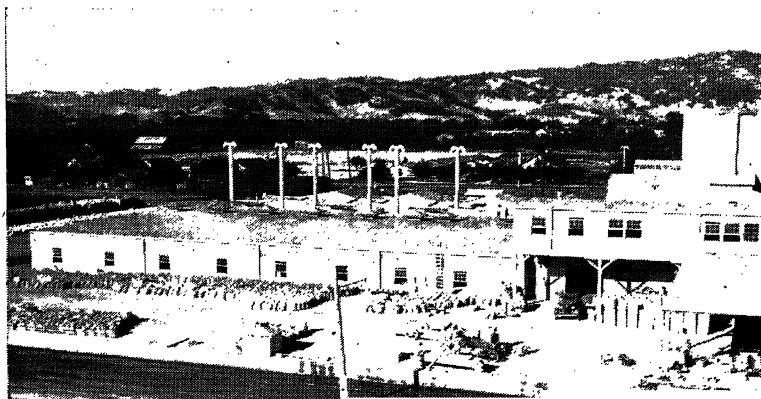
Ordinarily it takes years to establish an item firmly on the grocer's shelves. An astonishing number, familiar to all of us today, were unknown ten years ago. The war probably has cut this period of development to a third for the better distributors of dehydrated foods.

Dehydration is being used more and more in the drug and chemical field. For example, blood plasma and penicillin have been dehydrated to great advantage as they are preserved in this manner for a number of years instead of losing their value at the end of a few months. It is also expected that the potency of serums, vaccines, and anti-toxins may be measured in terms of years instead of months as at present through the use of dehydration as a method of preservation.

**Future Buyers of Dehydrated Foods.**—Below is a list of the 24 principal fields where dehydration should find a place:

1. Soft drinks
2. Vegetable drinks
3. Beverages
4. Baby foods

5. Health foods
6. Pharmaceutical products
7. Confectionery field
8. Ice cream products
9. Bakery products
10. Desserts
11. Soups
12. Seasonings
13. Jams, jellies, marmalade
14. Prepared dinners
15. Prepared meat dishes
16. Prepared flours
17. Prepared salads
18. Fountain syrups
19. Fruits
20. Vegetables
21. Cereals
22. Dairy and poultry products
23. Dog foods
24. Cattle feed



Plant of Basic Vegetable Products Co., Vacaville, Calif.

## CHAPTER VI

### PROBLEMS OF THE MANUFACTURER

**Points the Dehydrator Must Consider.**—Dehydrators have had to meet a number of complicated problems in their effort to improve the quality of their products. Not the least of these was the lack of a properly charted course. At the beginning of the boom period of plant development there were few sound established principles of procedure which newcomers could follow. Many of the large corporations entering the field felt that dehydrated foods, prior to 1941, were below the standard necessary for successful merchandising. Hence, they started working along new and independent lines. A few were successful but others frequently discovered that their apparently new ideas had been tried before and discarded as unworkable.

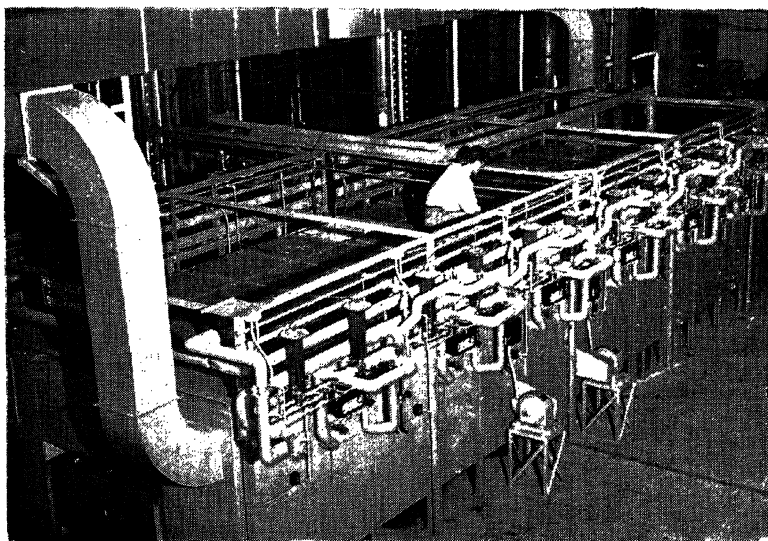
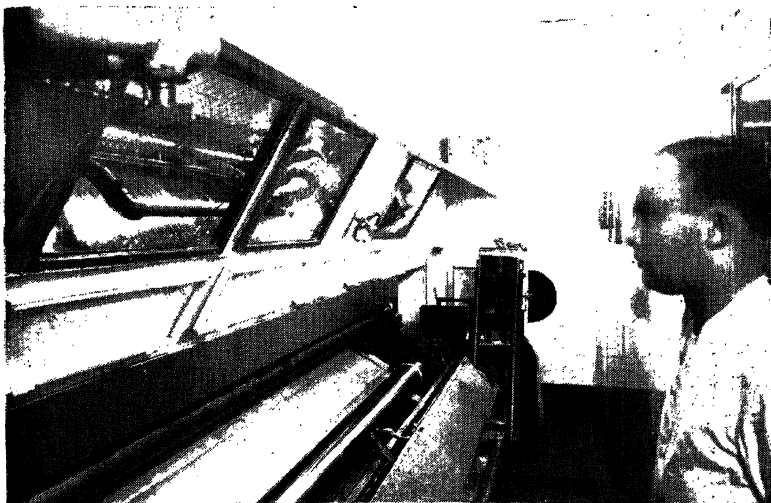
Each manufacturer had to determine first of all which of the two general types of dehydrated food he would produce, the so-called piece, or the powder or puree. Few undertook both fields since each presented enough problems without doubling up. The majority of fruit and vegetable dehydrators elected to do the piece type, using the tunnel or cabinet form of dryer of which there are many variations in each case. The principal products purchased by the government which are made in the piece form are:

beets	potatoes
cabbage	sweet potatoes
carrots	rutabagas
onions	

These products, when reconstituted, take their original form.

A few companies specialize in the powder or puree type, using the spray or drum drying equipment. Some of the products produced with such equipment are:





Top: Tomatoes being dried in sheets on the Sardik Drum dryer.

Bottom: Tunnel dehydrator at the Regional Agricultural Research Laboratory Albany, Calif.

apples	grapejuice
bananas	soups: bean
corn	pea
cranberries	tomatoes

**Various Processes Produce Various Products.**—Products which are made either in piece or puree form according to the purpose for which they are needed are:

apples	potatoes
asparagus	pumpkin
bananas	raspberries
carrots	spinach
cranberries	strawberries
onions	sweet potatoes

Eggs are usually spray-dried. Milk may be either spray or drum dried with the trend recently toward the first system.

Vacuum drying, which is used to some extent in spite of its higher cost, will produce either the powder or piece type. We believe this method will be a big factor in the future.

Practically all dehydrators working on government vegetable or fruit contracts were compelled to adopt the tunnel or the cabinet type of equipment. Those entering the egg and milk fields almost universally were required to purchase spray dryers. On the poundage basis, the industry as a whole offers at present much broader markets in drum or spray type of product. Approximately two-thirds of the foods to be produced during the season of 1943-1944 will be of the powder or puree variety.

Meats were processed first in rotary dryers which are still the most frequently used. Excellent results also can be obtained by the vacuum method but the cost of operation is great.

**Plant Costs.**—For the most part, present manufacturers are erecting small plants ranging in value from \$50,000 to \$250,000 and producing from 6,000 to 20,000 dry pounds per day. The average annual production from the first 100 plants placed in operation in 1942 was a little over 1,000,000 pounds each with a market value of approximately \$500,000 for each plant's output.

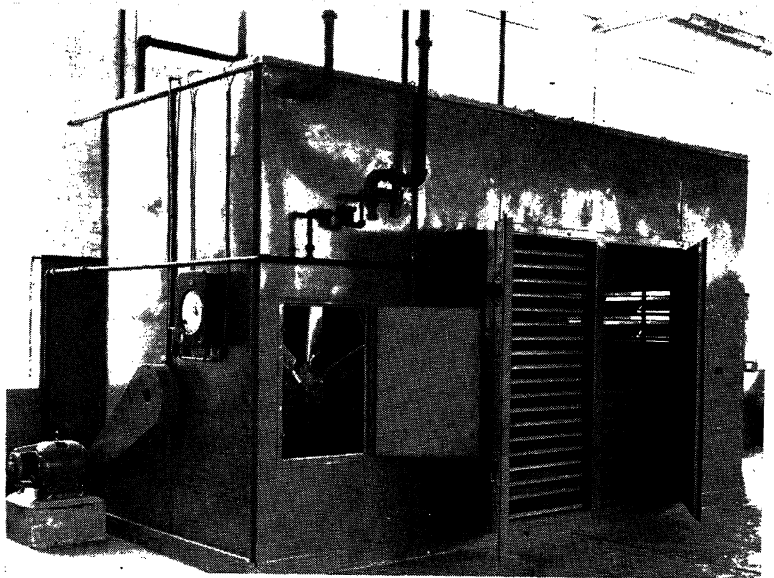
Manufacturers, who were not previously food processors, had to choose their locations carefully because of government restrictions, complications due to generally unsettled labor conditions, and problems of transportation and supply. Each company had first

to consider how to meet immediate government requirements. Those who could, and, at the same time, locate their plants with an eye to the post-war market were fortunate indeed.

**Selecting a Site.**—In selecting a site, the commercial dehydrator has to place greatest emphasis on the availability of raw material. The type best adapted to drying is not always the same variety as that used by canners and freezers. Generally speaking, it is necessary to dehydrate those with the strongest flavor and the highest vitamin content in order that the resulting product may retain better than average values. Although the operating season for the dehydrator is about twice as long as that of the canner, ready access to more than one crop should be sought to prolong the operating period and consequently lower the overhead. Other problems of proper location are the normal ones of the canner such as accessibility to market, transportation, power and water facilities, sanitary conditions, and sewage disposal.

When located, the present manufacturers purchased equipment which was approved generally by the government's Dehydration Committee. Standard canning machinery was installed for washing and trimming the raw materials, blanching and preparing them for processing. The dryer selected was, in many instances, specially designed and erected by a dehydration engineer rather than a standard model produced complete by a manufacturer. The government provided the services of a consulting engineer to aid new companies in making decisions which were difficult due to the many conflicting ideas as to the efficiency of the various types of equipment. There were, for example, 83 different cabinet, tray and tunnel dryers alone, on the market by the middle of 1943. In many instances, only one or two of each type were in actual operation and those only for a short period.

**Heat Control and Air Conditioning.**—The dehydrator soon found that certain characteristics of his product made efficient handling very difficult. All foods are hygroscopic and many require the use of extensive air-conditioning equipment. Likewise, their susceptibility to injury through oxidation demanded special precautionary measures. There was, too, the problem of bacteria control and insect infestation. Dehydrated foods in this respect are much like grains and eventually, many of the methods used at various stages in the milling of wheat, and so forth, may be adopted by the modern processor.



Top: Dehydration tunnel designed at the Beech-Nut Packing Co. Vestibule is at the right, two drying compartments in the center and the discharge chamber at left. Racks automatically move through tunnel receiving blasts of hot air from fans.

Bottom: Cabinet dryer showing placing of racks. Developed by Carrier Corp.

Advocates of high drying temperatures and short drying periods faced one problem and those favoring low heats for longer periods another. There has not been enough time since the industry became full size to determine which type of drying equipment and which method is best, or which form of heat control and air-conditioning is preferable. The first manufacturers had to make decisions and take chances. Out of their efforts should come sufficient working data to put the industry on a firmer technical basis. It can be said, however, that there is no one type of dryer which is best for drying all types of food nor any one method which will treat all foods.

The dehydrator, who can work largely from fresh produce and still keep his plant running eight months in the year, should be able to manufacture a more uniformly high quality product. While it is not necessarily a bad habit to rely on stored fruits and vegetables for raw materials, such products do lose a substantial percentage of their flavor, vitamins, and food values after a few months. As a rule, deterioration with some products starts after 30 days and with practically everything which customarily is stored, such as potatoes, sweet potatoes, onions, cabbage, carrots and apples, in not more than 90 days.

**Plant and Soil Selection.**—A study is being made by the Department of Agriculture and by research departments in various universities of plant and soil selection, and of climatic conditions best suited for growing the highest quality foods for dehydration. This is such an enormous problem that probably it will take several years to arrive at any conclusions for even a limited number of products. The subject is of the utmost importance to the dehydrator and a careful study should be made of all available data. This is especially evident when it is considered that the yields per acre for the same product will vary in different soils and climates as much as 500%. Likewise, different crops will vary in flavor and vitamin content to an astonishing degree. Differences of as much as 600% in the ascorbic acid content of tomatoes have been noted, and of over 1000% in vitamin A in other products high in this important vitamin, such as carrots.

Manufacturers who have elected to process foods of high protein value, such as peas and beans, have found their difficulties confined principally to proper pre-cooking after which the drying, packaging, and other handling operations are comparatively simple. Dehydrators concerned with high acid products, on the other hand,

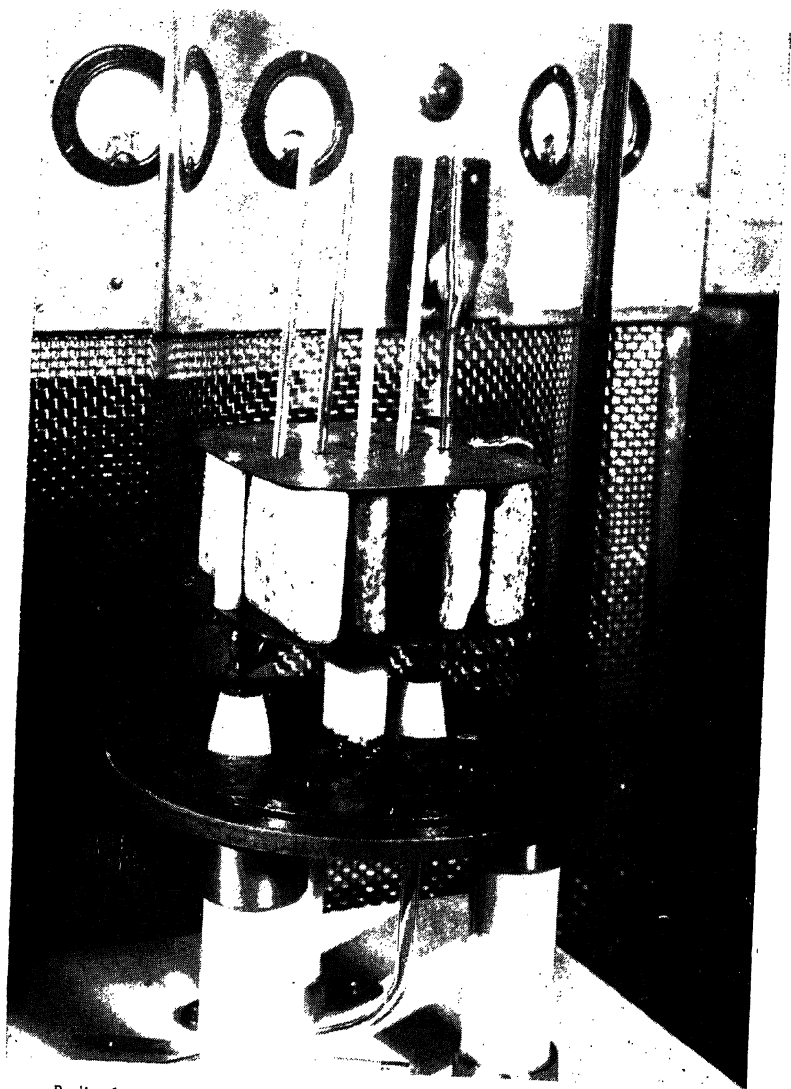
have found preparatory steps fairly easy but control of acids and sugars quite difficult, and packing problems much greater because of added difficulties in prolonging storage life.

**Areas of High Humidity.**—Processors located in sections where the humidity is normally high found their operations involved a higher drying cost due to this factor. Likewise, a greater investment was necessary in equipment for the proper protection of their finished products, which, in a damp atmosphere, absorb moisture quickly. In such places, it is necessary to package dehydrated foods in a completely air-conditioned room equipped with very close controls. There should be the least possible delay in completing the final packaging. In some districts, the humidity reaches as high as 90, others have the benefit of an average around 24 to 28. The difference in the operating cost between the two points represents a reasonable profit to the manufacturer.

A few plants, close to large cities or towns, faced difficult sewage disposal problems owing to the large amount of refuse resulting from handling 50 to 200 tons of fresh vegetables daily. Others ran afoul of city or town regulations forbidding the creating of odors such as those caused by the manufacture of onions.

In examining the conditions surrounding the location of more than 50 plants throughout the country, it was discovered that, on the basis of 100 for the ideal set-up, only seven companies rated over 70. This was, of course, an arbitrary method of grading but it does indicate the great care with which these problems must be considered. To test the general theory of proper selection, costs were obtained from a manufacturer of potatoes who rated 79 and from a second who was graded 30. The difference in cost of production, as closely as could be determined, was 7¢ per pound, or more than 15% of the average cost of the finished product. This was at least 5% higher than the normal profit allowed by the government.

**The Problem of Packaging.**—Most dehydrators have found, contrary to general impression, that war restrictions on packaging materials, such as tin, affect their industry almost as much as the canning trade. In the case of the less hygroscopic products, substitutes like glassine, cellophane, and other similar materials serve quite well but the more difficult dehydrated items are a headache. It can be said definitely that no satisfactory substitute has been found for the tin can. No matter what dried product is named.



Radio frequency fixture used in the Megatherm dehydration process of the Federal Telephone & Radio Corp.

it is preserved best and will retain its original flavor and vitamin content longer when packed in hermetically sealed tins than in any other known form of container.

The standard package should be air-tight, moisture and moisture vapor proof, resistant to fats and oils, insect proof, odorless, tasteless, opaque and gas proof. There is no other material in sight which will meet all of these specifications as well as the tin can. All dehydrated foods might better be packed in tin and in inert gas of some sort, probably nitrogen. The use of tin for all products will be argued as unnecessary by many experts but to insure a shelf life of several years, the fullest precautions are essential. For long life it is necessary to eliminate all danger of oxidation. All air can be removed from a can by means of a high vacuum. It can then be filled with nitrogen after which there is little or no danger from oxidation. As much as 99% of the oxygen can be removed in this manner. The entire future of the industry is wrapped up, so to speak, in packaging. Long storage life is an essential quality if dehydrated foods are to make possible the revolutionary changes in distribution which we have mentioned.

**Variety in Dehydration Packaging.**—Every conceivable form and style of package from the cellophane envelope containing  $2\frac{1}{4}$  to  $3\frac{1}{4}$  ounces to 30 gallon steel drums fitted with rubber gaskets and seal-tight tops are now being used. For the consumer market, manufacturers have adopted either the small envelope or carton, with or without an interliner or bag. For the institutional trade, the standard package used to be the No. 10 tin can, holding approximately four pounds of dried food. When this was ruled out because of war restrictions, paperboard cartons, impregnated with various chemical or plastic coatings, were substituted with a cellophane, glassine or similar type bag inserted, generally of laminated construction and heat-sealed. The larger packages, for shipment to manufacturers where further processing is to be done, were changed from steel drums to large paperboard cartons with wax impregnated interliners.

Paper companies, container manufacturers, and big chemical corporations have joined together in many instances to work out new types of packaging material. Converters have used many combinations of the various new materials in an effort to improve the quality. But combinations, even involving several layers of protective papers or coatings, have not been entirely satisfactory.



Manufacturers dealing with the commercial trade have not been as handicapped as they would have been normally since the general shortage of foods has reduced the shelf life of a product to the minimum. The period from factory to consumption has been reduced from six to nine months to three or four. However, dehydrators would suffer if they had to follow the canner's practice of packaging within three months a full year's supply for marketing.

Many products, such as pea, bean, and other soups, and potatoes, can be distributed commercially quite safely in the available packages. However, better packaging would improve them for long storage life, just as it would the more hygroscopic items such as tomatoes, carrots, cabbage, apples, and bananas.

While the original paper envelope was once the most popular package, the trend is towards a stronger type such as the small carton, familiar as the container for gelatin desserts. This offers greater sales and merchandising possibilities. A still newer form is the imitation can made of paper and plastics.

**Packaging Rooms Should Be Well Protected.**—Manufacturers have found it necessary to have the packaging room thoroughly air-conditioned and with close controls of humidity and temperature. In most cases, a temperature of 65° to 70°, and humidity around 38% is satisfactory.

Absolute cleanliness also is essential. Dehydrated foods are quite susceptible to insect infestation. Larvae, impossible to detect, get into the foods before packaging and although they may lie dormant for a long time, they will come to life under high storage temperatures. The use of ultra-violet rays and also mechanical treatment for the destruction of bacteria is recommended.

It is not sufficient to have ordinary air-conditioning in the case of hygroscopic foods. We would recommend filtering, washing and drying the air whenever possible. The best designed plants have the packaging room as close to the final step in drying as possible in order that there will be no delay in packaging and storing. The room should be completely sealed off from the rest of the plant.

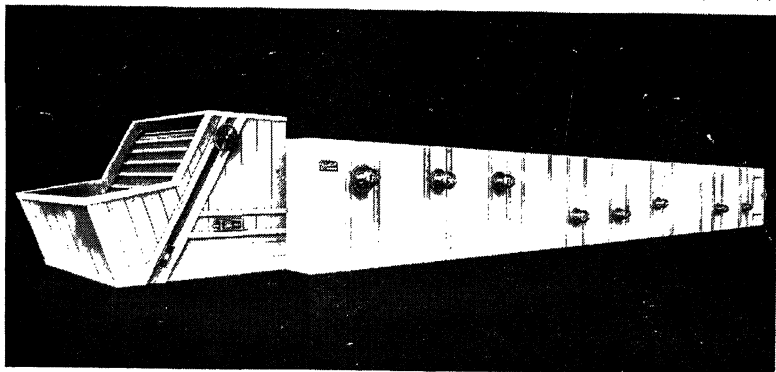
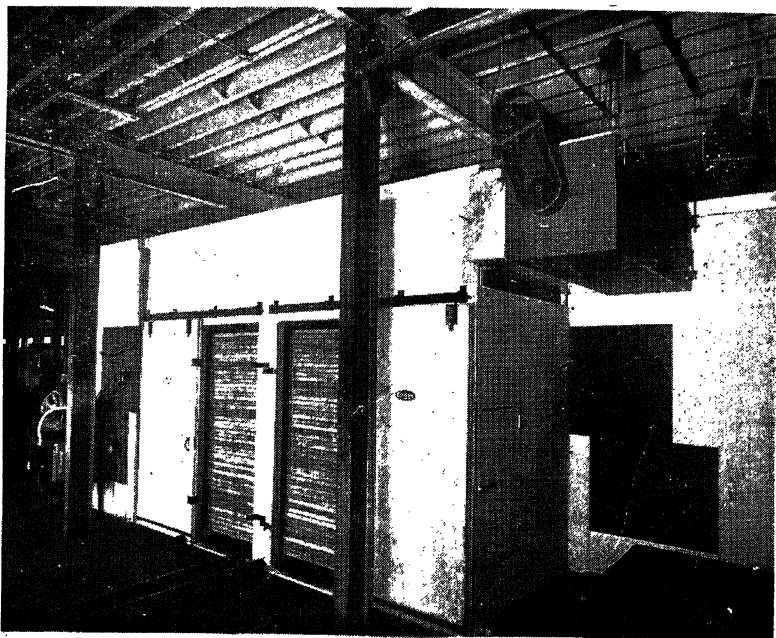
**About Vitamins.**—Another problem was created for the industry when the country became vitamin conscious. Canners, for many years, had been untroubled by any discussion of the vitamin content of their products. The majority of them never referred

to it. Certainly sales were not based on any public knowledge as to good or bad vitamin rating. However, the case of dehydrated foods is entirely different. The consumer's interest in this food characteristic was stirred to a high pitch before the war and before dehydrators had a market. Competing processors, as a result of the early impression that dehydration destroyed vitamins to an unusual degree, have made the most of their opportunity and have condemned dehydrated products as failing to meet standards set by other processed foods.

So much has been said on this controversial subject and so many expert opinions bandied about, that the picture is confusing. On reading many reports on the subject, it would seem clear that even the experts do not agree. The findings don't match up. This may be due to different methods of determining the vitamin content, different methods used in dehydration, or because of other varying conditions under which the tests were made. Dr. Donald K. Tressler's review of the available data on the subject should be studied. This was published, as Technical Bulletin No. 262, by the New York State Agricultural Experiment Station, March, 1942.

Rather than attempting to pass upon the accuracy of the many reports, it seems more worthwhile to consider vitamins from an entirely different angle. After all, the most important place to find vitamins is in the foods when they are ready to serve. It does not matter so much what method of dehydration was used or how destructive it was as how much vitamin content was in the original raw material.

**Vitamin C in Tomatoes.**—Let us take tomatoes. The vitamin C content in the original fresh product may vary as much as 600% according to the variety, where and how it was grown, and the soil conditions. If a tomato containing 600 International Units of vitamin C per 100 grams were dehydrated by a method preserving 90% of the vitamin content, the result would be 540 units retained. By using another method, which might preserve about 60% of the vitamin content, the result would be 360 units. Now, however, if the original tomato had only 300 units per 100 grams, even 100% retention by the best method of drying, would result in fewer units being retained than if a very poor drying job were done on the better raw material. From our point of view, then, the whole question of vitamins depends upon the proper selection of raw material. To show what difficulties this presents, it is only necessary to



Top: Another type of cabinet dehydrator designed by Carrier Corp. At the John H. Dulany & Son, Fruitland, Md., plant.

Bottom: Tunnel type dehydrator developed by Proctor & Schwartz, shown from the feed end.

point out that tomatoes harvested the same day and from the same field, will vary as much as 50%, and even if taken from the same basket, picked at the same time, might show as much variation.

Looking at the problem from another angle, it is well known that raw materials, if stored for months, will change their characteristics. The dehydrator might purchase the highest quality potato during the harvesting season and turn out a high quality product. However, if he continued to operate on the same crop over a period of several months, the finished product would become steadily lower in quality. This would also be true of sweet potatoes, onions, and many other products.

One of the difficulties is that certain steps in dehydration necessary to obtain the best results may be injurious to the vitamins. For instance, blanching, even if properly done, may destroy some of the vitamin content. Likewise, sulphuring of fruits might preserve one vitamin and destroy another. Inferior packaging might not affect the color or flavor immediately but would lower the vitamin content through oxidation. Too much heat will destroy vitamins, but in some cases, fairly high temperatures are necessary. All these factors indicate that a nice balance has to be maintained in the operation from the start to finish.

Other characteristics of certain foods are important to preserve. The pectin content of some fruits and vegetables is lost very quickly after they are trimmed or sliced. The proper relation between sugars and starches is difficult to maintain in products such as corn, peas, and bananas, unless they are handled very rapidly. The vitamin content, however, seems to be the chief concern of the food technologist.

**More Vitamin Factors.**—In brief, it can be said that most vitamins are as well preserved in dehydrated foods as in canned or frozen. In a number of cases, such as spinach and beans, some of the vitamins are preserved better by dehydration than by canning. Ascorbic acid, or vitamin C, is preserved better in dried milk than in freshly pasteurized. This vitamin is one of the most easily affected of the important vitamins and the most difficult to preserve. Hence, it is often used as a yardstick in determining the efficiency of all methods of preservation. There is a wide variation in the percentage of retention. High acid fruits and vegetables retain vitamin C to a much higher degree than other foods. Independent

## DEHYDRATION, ITS POST-WAR FUTURE

tests of tomatoes have shown retention as high as 92% with an average of 85% to 88% by the drum drying method.

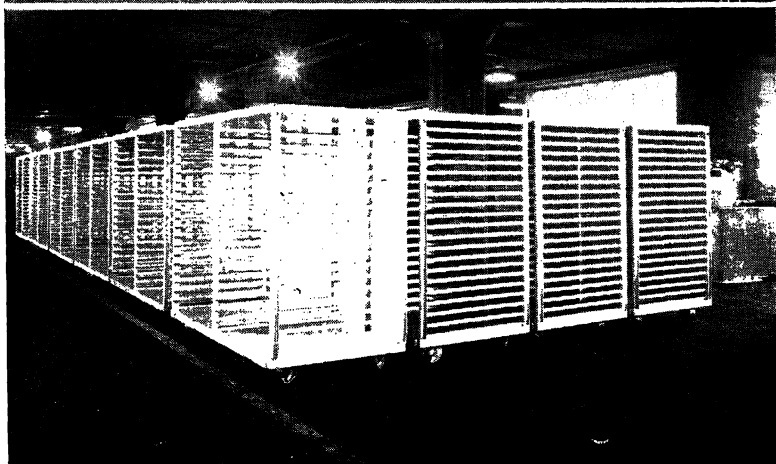
The average vitamin retention over a period of nine to twelve months is not as good as it should be, principally due to imperfect packaging materials and failure to remove oxygen completely by high vacuum packing combined with the use of gas.

There is another important point to consider in connection with vitamins. What the food processor does in the way of destruction is nothing compared to what the housewife does under average cooking conditions. It has been estimated that as high as 90% of vitamin C is lost in kitchen operations with some foods and that the average is between 40% and 60%. Of course, it is important that under such circumstances the housewife have the highest possible vitamin content to start with.

If these facts are true, there is one important point in favor of dehydration which is not often given the attention it deserves. The form of dehydrated foods, which we believe is designed to become the leader, is pre-cooked and ready to serve after heating to serving temperature. Such foods help the housewife to avoid the big loss in nutritive values from her own cooking. It must be conceded that the efficient processor, operating under close controls, can cook the food with far less destruction to essential food values.

The pre-cooked type reconstitutes almost instantly and does not require soaking or any long period of preparation. Great strides have been made in the past few years in shortening the time of preparation for the housewife. As further means are found to cut down the actual drying time, it will be possible to process more and more foods which will be pre-cooked and instantly rehydratable.

**Problem of Flavor Retention.**—The problem of flavor retention is not wholly solved. Off odors noticeable after a few months in storage may be due to less well known enzymes improperly inactivated. A very low moisture content helps with this problem but much further study will be necessary before the cause and cure will be found.



Top: Type of glass piping now being used in food processing plants. (Courtesy Corning Glass Works.)

Bottom: Trucks being used in multi-stage dehydrators.

## CHAPTER VII

### MARKETING: THE CUSTOMER'S ANGLE

**The Distribution of Dehydrated Foods.**—Throughout our earlier chapters we have touched upon many phases of the marketing problem but the subject is so important that it is well to call special attention to certain aspects of merchandising which it will be necessary to consider carefully if a broad market is to be developed.

The actual merchandising and selling of dehydrated foods follows the same lines as in the case of packaged or canned. Brokers are employed by many manufacturers while others follow different methods of selling directly to wholesalers, chain stores, big buying institutions, and directly to the manufacturer.

Discounts and commissions are similar to those in the canned and packaged goods field. The big chain stores, large department stores and specialty food shops on the retail side, and the wagon jobber on the wholesale, were the first outlets for dehydrated foods and have continued to be the biggest distributors.

The manufacturer and distributor of dehydrated foods have used all the customary merchandising methods such as advertising, broadcasting, sales demonstrations, and so forth, that have been used in promoting the better known canned and packaged foods. In other words, there is nothing new in marketing dehydrated foods. They offer no new problems as far as getting the goods to market is concerned. However, they do present some features which at present make them a little more difficult for the distributor. These unusual conditions are brought about chiefly by the strange appearance of the products, themselves, and the temporary lack of entirely suitable packaging materials to preserve them properly for a long shelf life.

**Greater Emphasis on Food Value.**—From the standpoint of both the food and the package, the biggest sales resistance comes from the lack of eye appeal. The packages are not unattractive

but they give the impression of offering very little for your money. Greater emphasis should be placed on the comparative food values of the dehydrated food package and the fresh, frozen or canned package of equivalent price. The housewife might pay 25% more for a bag of potatoes which bulks large and heavy because she is not convinced immediately that the small compact package, one-twentieth the size of the bag, really will make her more mashed potatoes for her dollar.

**The Distributor's Problem.**—The problem of storage life affects the new product seriously because it is only natural to assume that in many places it may be a little "sticky" and will not move off the shelves quite as rapidly as it should. The packages, then, become dirty and mussed up, making the display unattractive and further retarding sales. This is often the case with the envelope type of soup package commonly used. The small carton, or three small envelopes encased in a carton, makes a better display, and, as a rule, will keep in better condition.

There is another angle to the distributor's problem of keeping the display fresh and attractive. If the contents are hygroscopic and if the package does not protect them adequately, the food may be hard to prepare when the housewife gets it home. For this reason, merchandisers should keep their customers' stocks as low as possible and moving as rapidly as possible, even to the extent of taking back merchandise which has remained on the shelves more than a few weeks at the most.

The most important point in marketing dehydrated foods is to get the customer's angle and to understand how these products appeal to the buyer. Here the distributor finds he has a real task to perform in developing a proper attitude towards dehydrated foods on the part of all his customers.

**The Customers' Attitudes.**—These might be classified generally in three groups: the manufacturer who may use his ingredients as a part of specialty foods already on the market; the institution, club, hotel or other big retail buyers such as factory restaurants; and the housewife. What the attitude of each of these three groups will be in the future will depend almost entirely on what attitude they take right now at the beginning of the first wide interest in dehydrated foods. It is said in the case of children that the first few years of education are more important than all the rest of their lives in establishing character. So it is with prospective



customers. If they get started right, they will keep on buying but if they have a wrong conception of dehydrated foods, they probably will forget all about them and never take them up again.

What to do to establish the correct conception of dehydrated foods in the customer's mind can be summed up in one phrase: an educational campaign. There is the widest possible variety of opinions regarding these foods. Some people think anything can be dehydrated. Many think such foods as are dehydrated can be used for any purpose. Others, some of them experienced food people such as hotel chefs, army cooks, dietitians and food technologists, think they know more about how to prepare them than the manufacturer. They refuse to believe directions for using them properly. All of these people must be set straight or there will be trouble in popularizing the new products.

Before starting out to educate somebody else, it is necessary that the manufacturer and distributor know their own lesson. Few have any idea how their products can be used to best advantage. There are too many labels which name an endless number of uses. Tests made in experimental kitchens often show that while the product may be good in two or three of the cases mentioned, it is unsatisfactory in the others. In some instances, there is such a wide difference in the quality when used in various ways that the less satisfactory methods should never be suggested. Certain manufacturers have been operating on the belief that a product cannot be sold without indicating a large number of uses. Of course, this is an advantage if the food is really satisfactory in every case. It is a distinct disadvantage if this is not true.

**Rehydrating Directions Often Faulty.**—Then there is the competitive angle which causes a lot of trouble. The manufacturer and distributor are claiming constantly that their products can be prepared by soaking for five or ten or fifteen minutes when the period should be doubled or trebled. They state that their soup, for example, is an instant soup, ready to serve in three minutes. While it can be prepared in that way, in many instances, it is much better if it is given a ten minute preparatory period. So often the directions read: "All you have to do is to add a cup of water, stir and serve." The chances are against getting entirely satisfactory results in this way.

Why try to guess how much time the housewife has available for preparing her dinner? She can always shorten it if she has

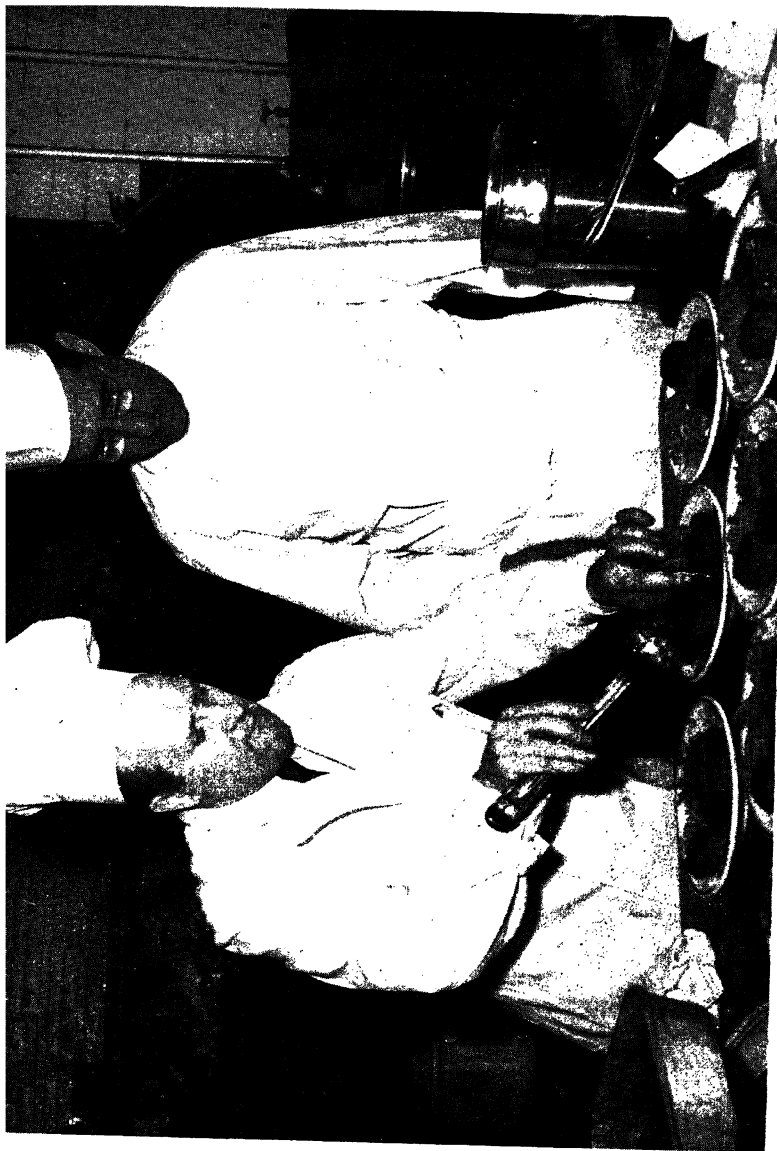
to but she probably will be much better satisfied to be given the correct instructions for preparing a food in the best possible manner. Contrary to the practice of the manufacturers referred to above, there are others who seem to be in doubt as to how their foods should be used. They do not give the housewife much of any help, making no real suggestions, providing no recipes and offering only meagre instructions.

**Danger in Exaggerated Claims.**—Still another bad feature is the manufacturer's tendency to claim that his product is the equivalent of more fresh or canned food than is actually the case. This is usually an attempt to establish a difference in price which will make the customer buy. Frequently, the housewife, who has to stretch the material too far will become a dissatisfied customer and will refuse to buy again, price or no price.

It would seem that the best start towards establishing a sound point of view regarding dehydrated foods would be for the dehydrators to get together to plan a joint educational campaign using all the normal channels of publicity. In this way, uniform statements would be made, exact facts would be available, correct and conservative information would be the rule, and confidence established in the minds of the customers. A much broader public could be reached and a more consistent educational program carried out over a long period with the individual manufacturer and distributor fitting in his own merchandising campaign with the major one. This would result probably in greater effectiveness for each advertiser's and merchandiser's campaign.

The manufacturer of processed foods has his own problems. To the dehydrated food distributor who wants to make a customer, the manufacturer's problems must become his problems. He must know exactly what they are and have a clear idea of how his own product can help to solve them.

For instance, the dehydrator is a manufacturer himself and starts with raw materials which can be processed in many different ways to meet the needs of the manufacturer or processor of other types of foods who are to become his customers. The dehydrator, with this type of customer, does not have to have, and, perhaps cannot have a standard type of product. He should, instead, be prepared to take advantage of the great flexibility of his own process to meet the exact requirements of his customer. In this



Dehydrated foods are of increasing value to the institutional trade. Here, meat and vegetables are being served.

way he will build up a satisfactory and continuing demand which should hold for many years.

**Must Study Problems of Industrial Buyer.**—As an example, we might cite the case of one dehydrator who tried to sell his product to a vegetable sauce manufacturer. Every time he was asked, he sent the same sample of his product to the sauce manufacturer and each time there was no sale. Finally, he undertook to give some real thought to the sauce manufacturer's problems. He found that by changing his grinding machinery and eliminating one important ingredient from his product, he could meet exactly the conditions of the manufacturer. Although it cost a few thousand dollars to make the change, he received a substantial order which has multiplied several times during recent years.

Today, manufacturers are skeptical of dehydrated foods. They won't take the time or make the effort to study the problem of fitting them into their own process. If the distributor will educate the manufacturer and demonstrate the wide variety of types and kinds that can be made, the changes which can be brought about in form and texture, in flavor, color and vitamin content, he will buy in tremendous quantities, because, on the average, he will find that they will save him much money. The manufacturer of a well established brand cannot fail to hesitate about changing his product in any way. He has to be convinced of the quality of dehydrated foods, and, further, that if his own customers know that he is using dehydrated products, they will be satisfied and will continue to buy. This brings us to the second type of food buyer.

**Handling the Institutional Trade.**—The hotel, club, hospital, institution, factory restaurant, chain restaurant, and others, buy largely in bulk. While the larger quantities are quickly consumed in most cases, many items are bought for stock and are carried on their shelves for a considerable period of time. Sellers of dehydrated foods claim they can be packaged and stored away so as to be available when needed. But dehydrated foods won't keep in large packages for any length of time unless they are stored properly in a comparatively cool place. They will not keep if the package is so large that the cook uses only part of it at a time. When the product is partly used, the busy chef often will leave the container open for an hour or two, or the cover will not be fastened down tightly. When next the food is needed, it will be unsatisfactory.

The average institutional purchaser is led to believe impossible things in the way of savings, special advantages, and so forth. The dehydrator must make a closer study of the institutional buyer's habits and activities in the kitchen. He must warn against the dangers of storing the product improperly. Above all, he must make it clear to the large institutional stewards and cooks that no matter how great their knowledge of foods, they should follow explicitly the directions for preparation of dehydrated products, at least, until they have had an opportunity to experiment with them and to prove definitely that their own ideas are better than the manufacturer's.

In the case of one dehydrator of fruit powders, two years were spent in selling the buyer for a large chain of hotels. Finally, a demonstration was arranged which proved to be completely satisfactory to the whole staff of the largest hotel in the chain. Consequently, a small trial order was placed. After the delivery of the material, the dehydrator's representative went around to inquire as to the successful use of the new jelly product. Much to his consternation, the chef was almost ready to throw him out. Upon investigation, it was found that, whereas the instructions were explicit, the chef had thought up a new and better way to make jelly—with disastrous results—and unfairly enough, the end of sales to the hotel chain.

Such lessons are the lack of proper education. Once a chef has tried a dehydrated food and found he could not use it, he is loath to try any others and the whole industry suffers. At present there are a great many stewards in clubs, hotels, and institutions who have been using large quantities of dehydrated foods for a long time. They became interested enough to supplement the manufacturer's knowledge with their own experience with foods of all kinds. They learned the characteristics of dehydrated foods and adopted them to their own purposes. Many claim that dehydrated foods are better for some purposes than any other type of food, even fresh, that they can get. Strangely enough, even though the foods are good, some club stewards are reluctant to boast of their new dishes because they feel public acceptance is lacking. This brings us to the housewife.

**Educating the Housewife.**—Surveys conducted in many cities all over the country have indicated the keen interest on the housewife's part in new foods, among them, dehydrated foods. Inability to get many of her standard items has led her to take a great interest

in all new forms of food. This gives the dehydrator a remarkable opportunity which he may not get again in a generation. These same surveys indicated quite clearly how many misconceptions the housewife has. She gets frozen and dehydrated foods mixed up—she calls them health foods and vitamin foods or substitutes.

But what they are, how they are made, what they can be used for, and how they can save her money are things she definitely does not know.

It is unnecessary to go into much detail about what the dehydrator must do to win the housewife. In simple terms, he must convince her that dehydrated products are not substitutes, not make-shifts or temporary foods here for the war only; but that they are real, quality foods, just as well and as carefully made as frozen or canned; that they are made from the finest raw materials; and that they have characteristics which frequently make them better foods to use than canned, frozen, or fresh.

This does not mean that the dehydrator is trying to convince her that dehydrated foods are better than the other types or that they are as good in all cases. It is only that they have special uses and can be treated in special ways to make certain dishes more attractive. The question of proper recipes, complete directions, conservative claims, full explanation of equivalent values in terms of foods with which the housewife is thoroughly familiar has been stated above.

The most successful way of proving the palatability of dehydrated foods is to demonstrate it in the store. Let a housewife taste them. If she likes them, she will buy. But that is only half of the battle. In many instances, she will come back and say she could not make the food into as palatable a dish as the one she tasted in the store. This gets back again to improper instructions, incomplete directions or exaggerated claims for the product. All of these things will be overcome in time but time is of the essence with the food dehydrator because, at present, he is being given a free opportunity to demonstrate. Later, he will have to fight for it.

**Present Educational Efforts Disjointed.**—An important feature of the marketing problem is that, in spite of its best intentions, our government has not helped to popularize dehydrated foods or to establish the industry commercially. It has not found it possible to do this and to promote the more important war effort

to the fullest extent. This has left a poorly directed series of marketing campaigns by the individual companies, who, unfortunately, are not together in their statements regarding dehydrated foods.

In contrast, the attitude of the British Food Ministry is interesting. Here, of course, the problem was entirely different. England had to use a certain amount of dehydrated food. They simply could not use the ships needed to transport to England other types in sufficient quantities. The problem, therefore, was to educate the people quickly to make them like dehydrated foods. This they did by preparing very attractive booklets and other forms of advertising fully describing dehydrated foods, explaining how they could be used and encouraging the people in every way to try them.

Food experts tried hundreds of ways of using the different dehydrated foods the government was buying for distribution throughout the country. The dishes which proved to be best were recommended to the people and their successful use of them established the right attitude. In these directions and explanations the government did not claim that dehydrated foods were better than other types, but they did say that they could be used in many instances to better advantage than fresh or canned—that often well known English dishes could be prepared most attractively by using dehydrated foods, at least, in part. They emphasized, too, that the taste of dehydrated foods would not be the same as fresh or canned or frozen but they had a good taste and flavor of their own and undoubtedly, in many cases, the consumer would like them better than other forms of processed foods. Such has been the case.

If we in this country will adopt the same sane attitude towards dehydrated foods, accept them as good foods even if slightly different in form, flavor and character, we will find that a market and a broad one will be well established and acceptable uses will grow as knowledge increases.

**Rehydrating with Other Than Water.**—What we have learned in the last two years about cooking dehydrated foods easily has doubled their usefulness. We know they rehydrate more effectively in other liquids than water since they soak up flavoring more evenly and thoroughly than fresh foods in many cases when mixed with juices, gravies, milk, and so forth. We know, too, that they can be used to enrich other dishes by adding less than the normal amount of liquid. They are excellent fillers and bases for many popular dishes. They can be used to add new and unusual flavors to old

recipes. This is particularly true of desserts, soups, sauces, stews and meat dishes. The Army has a cook book on dehydrated foods. It is far from complete but is a start. The industry badly needs a book of this sort for the housewife and the chef. We are glad to note that such a book is in course of preparation under the auspices of the National Dehydrators Association and is being written by one of the best known experts in the cooking of dehydrated foods.

**The Foreign Market.**—This chapter would not be complete without some reference to the post-war foreign commercial market. Representatives of many countries have made surveys of our industry looking to the purchase of different types of foods processed here which they believe might have a favorable reception in their own land. To those dehydrators and distributors interested in this market, we suggest avoiding any attempt to sell foods processed particularly for the domestic market as foreign tastes differ greatly from ours in many respects. It should be easy to prepare special formulas for soups, desserts, and so forth. Without this precaution, failure is almost certain.

The form of packaging, also, should be given close attention. More compressed foods are used abroad than may be the case here. As long as they are readily accepted there, the advantage of the saving in handling and transportation costs might well be taken. It goes without saying that the cooking and feeding habits of foreigners will have to be studied and complete instructions printed in the proper language.

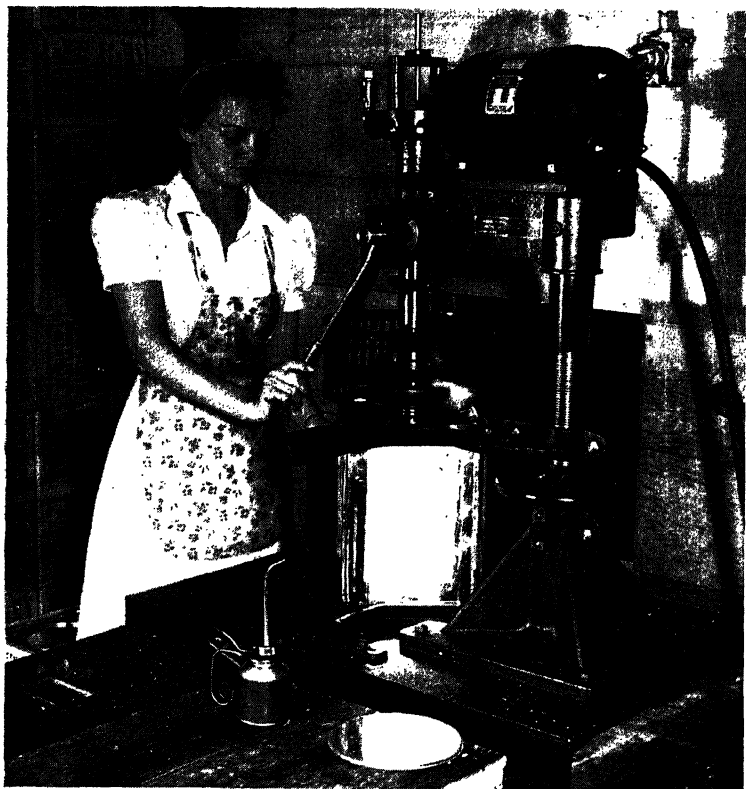
If cargo planes of the future become as important a part of our transportation system as experts now indicate, dehydrated foods will have a big advantage. They might quite easily be the only type of food which a distributor could afford to send in quantity by plane as the rate per pound is bound to be very high for air transport for some time to come.

It is fairly certain that air transport will be the means of bringing remote places within market range. For some years these remote spots may have to rely entirely upon air transport for their supplies. While this market may not be very great at first, it should grow and should offer a very attractive profit per pound of product sold.

From a study of conditions in more backward foreign countries, some government experts have become convinced that a better



balanced diet is as badly needed as more food. Dehydrated foods lend themselves so well to vitamin enrichment or fortification and to blending and mixing to provide just the proper amount of proteins, fats, carbohydrates, and so forth, that further development of the government's active interest along this line should provide a very sizeable market worthy of the closest study.



Cans of dehydrated cabbage are hermetically sealed in tins at Turlock, Calif.  
(Photo courtesy Farm Security Administration.)

## CHAPTER VIII

# DEHYDRATED FOODS OF THE FUTURE

**Dehydration Systems of the Future.**—Present day dehydrated foods, as previously indicated, are manufactured principally by what is known as the tray or cabinet, tunnel, drum and spray drying methods. Taking these as a basis, as well as vacuum drying which is now used to some extent, a wide variety of new types of equipment are being developed and important research may produce better dehydrated foods than any we have yet known.

While all of the following methods are not necessarily new, they are not yet fully accepted commercially. They are listed without regard to their individual importance.

1. Combination vacuum freezing and drying.
2. Heatless drying.
3. Stage drying.
4. Diathermy.
5. Infra-red rays.
6. Combination flash pasteurization and drying.
7. Drying with inert gases.
8. Explosion drying.
9. Complete dehydration unit: continuous operation with preparatory, blanching, dehydrating, and packaging equipment complete in one machine.
10. Freezing and drying.
11. Freezing and sublimation.
12. Radio frequency energy.

Exact details of these methods cannot be published as their final form is as yet unknown. The companies most interested in their development have not considered the experimental work sufficiently far advanced to warrant giving full information to the public.

**The Plant of the Future.**—On the theory that a food plant cannot be too sanitary or its operations too free of manual handling, one engineer has designed a revolutionary type of building for the future that it is claimed would improve the products by 20%, even using the present known methods of dehydration. While more expensive to build, he believes it would be cheaper to operate and that the goods would command so much more money that the additional plant cost would be recovered within a short time.

The basis of the structure is completely washable, using glass blocks or glazed material. Floors are not cement but are glazed and washable such as tile. All equipment is stainless steel except for pipes through which the material flows. These are glass, of a common type now manufactured by several of the big glass companies. Side walls of the continuous tunnel or cabinet dryer are of glass. The entire operation can be viewed from the outside. Preparatory equipment of all kinds is of glass with no metal touching the food in any way.

The entire building is tightly sealed, air-conditioned, and insect-proof. A special receiving room for incoming materials is partitioned off from the rest of the building and the goods treated before they are allowed to enter the plant proper. Continuous operation is designed without transfer or movement of food from one part of the factory to another. Liquids are piped directly to the drying chamber. Raw fruits and vegetables are sorted, graded mechanically, and moved forward in glass containers on white rubber belting. Complete control of humidity and temperature in the entire building is supplemented by complete coverage of all foods in glass channels as they are moved along. In the last stages, the product is mixed with gas to drive out the oxygen before packaging under vacuum, or in CO<sub>2</sub>, or nitrogen. The air throughout the plant is filtered, washed and dried.

The amount of mechanical equipment used and the labor saving steps involved reduce the number of employees in such a plant, capable of producing 40,000 dried pounds daily, by 16 persons per eight hour shift. The cost of the factory is estimated at \$750,000, complete. Many of the devices included are in use today in other types of food plants.

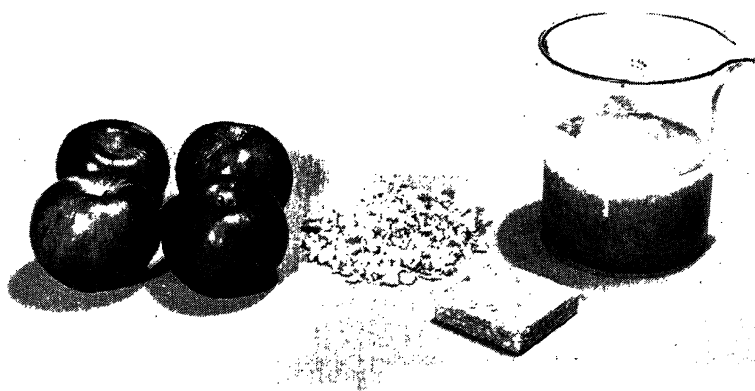
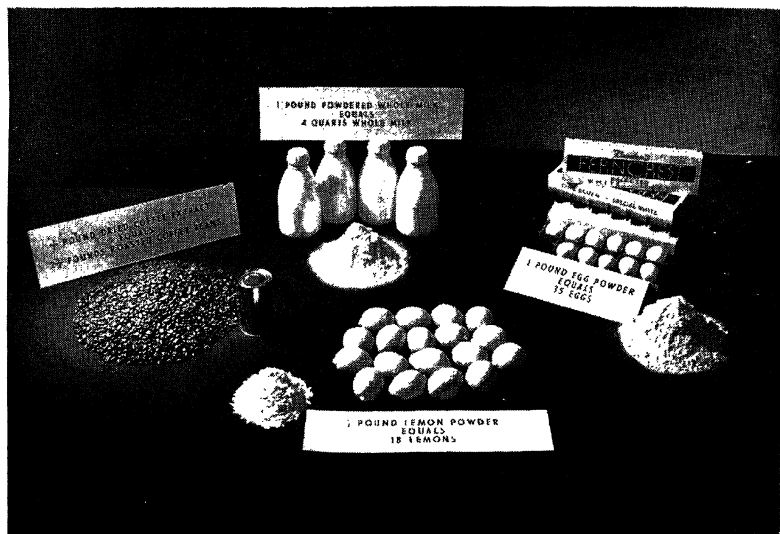
If all the best methods can be incorporated, it will be possible to improve operations as they exist today in at least 90% of the

plants. Once the industry is firmly established with a postwar market, it is hoped that many such plants will be in operation.

**Compression.**—Packaging ideas are almost too numerous to mention. One, while not entirely new since it has been used in Europe for many years, but which has received the greatest attention recently here, is compression. This reduces dehydrated foods to the most compact form possible without injuring the rehydrating characteristics. There are several ways it can be done. The combination of low temperature freezing and compressing, it is claimed, will permit the most compact package without injury. The pressure required and commonly used varies according to the product from 500 to 2500 pounds per square inch.

When dehydrated foods first were introduced, they were packaged as lightly and as loosely as possible. A gallon tin completely filled at the outset would, after continuous handling or transportation over a considerable distance, shake down to where it was about 60% full. The theory was that this form would reconstitute more readily. The pieces would not break down into too fine particles and they would rehydrate more easily to their original shape. Such loose packages contained oxygen which is detrimental to the long life of the product and destroys vitamins. When it became necessary to conserve space, manufacturers began to pack more tightly. In the case of cranberries, for example, the regular type of container, the No. 10 tin can, which previously had contained one pound, now contains four. This was accomplished by screening the material after dehydration to about an 80-mesh. Since this did not seriously affect rehydration, it has become standard. Compression starts at that point and reduces the space by 30% to 80% according to the product. When properly done, the little cakes of compressed foods will crumble in your hand quite freely once the outer wrapping is removed. It is claimed that the surface exposure to oxidation and moisture absorption is reduced in some cases almost 1000 to one. Over a period of time, however, the cakes absorb enough moisture on the surface to become encrusted. While the outer layer or crust adds an excellent protection to the remainder, it is usually difficult to rehydrate.

Certain foods, which are dried so as to make rehydration possible into their original form, break down into fine pieces and become mushy. The process of compression can be carried too far, but within reason, it offers a new economy in packaging.



Top: Some interesting milk, eggs, lemon powder and coffee comparisons.  
(Courtesy The Borden Co.)

Bottom: 1 pound of apples, fresh, dehydrated, compressed and reconstituted.  
(Courtesy Du Pont Co.)

Whether or not these cakes, which are usually four or five times the size of a yeast cake, will have sales appeal is another question. One of the great difficulties in the promotion of dehydrated foods is the lack of eye appeal. The customary envelope or small carton used today resembles a standard type of packaged food to which the public has grown accustomed. Whether they can be induced to buy the other as quickly must be proved. It is well to examine this method of packing thoroughly before determining the final form to be adopted.

**New Packaging Ideas.**—A second type of packaging, which has many interesting features, is the use of a plastic container similar to a toothpaste tube except that the screw top opening is much larger. It is claimed that there is no waste of packaging material as the tube is filled completely rather than partially as in the case of the envelope. In addition, it is firmer, makes a better display, and does not soil or crumple easily. Perhaps the strongest point is that such tubes hold sufficient food for six, eight, or even ten servings and would be more economical in packaging than two or three envelopes containing the same amount. The housewife, also, could open such a tube, use a portion of the contents and close it tightly to be used again later. This is not possible with the envelope where the entire contents must be used once it is torn open. Variations are the headless tube. In this case, one end is cut off with the kitchen knife and the entire contents of the package used at once.

The individual serving package is coming into greater and greater use. These are made of leadfoil, aluminumfoil, cellophane, glassine and other materials. They are designed for drugstores and other quick lunch establishments where such products as instant coffees and instant soups are served in great numbers to individuals.

There is a gelatin capsule containing dehydrated foods. This is usually a single serving and is used by dropping into boiling water. An interesting variation is a capsule in which two ingredients are placed in separate compartments. When dropped into boiling water, the contents automatically mix with the gelatin.

Likewise, there is a small individual envelope made in three compartments. One usually contains the dehydrated food; the second, spices; and the third, an ingredient that might turn the other products rancid if dried and mixed. Here the housewife is

instructed to open all three packages and to mix them immediately in hot water.

Imitation cans with bodies made of chemically treated paper, metal bottoms and tops, either hermetically sealed or of the removable top type, are now being offered by the can manufacturers. They are proving popular as they will permit the distributor to change over to the tin can without changing the form or appearance of the package if found desirable after the war.

**Home Drying.**—The increased popularity of the new foods has led to experiments in various types of drying units designed to accommodate everyone interested in dehydration. These range from the home dehydrator costing from \$5.95 to \$200, the community dryer ranging from \$500 to \$3000, and the mobile dryer \$6000 to \$27,000.

In the spring of 1943, impetus was given to home drying by the efforts to popularize the operation by utility companies and big manufacturers of electrical equipment. The Victory Garden campaign was widespread. Owners of gardens soon found they had surplus fruits and vegetables on hand with no place to sell them at a profit. They could not be given away because everyone else had a Victory Garden. To save the food, resort was made to home dehydration. While there is some merit in the practice and theory, actually more food was wasted than preserved. The housewife found it was not simple to dehydrate properly and to package so that the food would keep. The result was second-rate dehydrated food which has not helped the consumer's general opinion of the commercial process. It is hoped that the home operation will not spread until the whole industry has been shaken down to more definite standards and the small home unit can be improved. Such "ordinary necessities" as electric refrigerators, vacuum cleaners, oil burners, and others, did not attain general household acceptance until they had been made fool-proof. We believe the same thing will prove true of home dehydrators.

Two of the best pamphlets on the subject of home dehydration were issued in 1943 by the Massachusetts Agricultural Experiment Station (Bulletin No. 404) and by the University of Tennessee Agricultural Experiment Station (Bulletin No. 183). These might well be studied by those who wish more complete information.

A picture of a home dehydrator is shown on page 91. The



A typical home dehydrator in operation



device is very simple, consisting of a cabinet made of wood or sheet metal with trays and with electric bulbs inserted in the bottom for heating. There is usually an outlet at the top and a small fan to increase airflow. If careful attention is paid to temperatures at all times and if the unit is provided with reasonable controls, a better result is possible than the farmer obtains from hanging corn and other vegetables in the attic or shed, or by spreading them in the open to be sun-dried. Nevertheless, not many of us would eat much of that kind of food today. Too much emphasis is being placed on vitamins and other nutritive values. It is fairly well accepted that home dehydration destroys a high percentage of the vitamin content. The most serious difficulties, however, are the danger of improper preparation and packaging, which could lead, among other things, to illness through food contamination.

The community type of dryer seems to offer greater possibilities as the next step down from commercial dehydration. These small units, capable of producing from 500 to 2000 pounds of dehydrated food per day, could be set up quite readily in any convenient location where steam, electricity and water are available. Small lots could be dehydrated for individual families just as foods are now being frozen in locker plants throughout the country. In this case, there would be an experienced man to do the actual dehydration.

The amount of work to be done by such a dryer would warrant the installation of the best controls, blanching and packaging equipment. It would be, in effect, a small commercial plant. A number already have been installed on an experimental basis and undoubtedly the idea will spread. Some are made largely of wood and other cheap and obtainable equipment. Some such dryers are on the market, for sale complete with the necessary preparatory and packaging equipment of the best type, as they should be, to get the best results. The batch cabinet dryer is the most economical to use in such a manner and would be efficient in drying a wide variety of fruits and vegetables.

**The Mobile Unit.**—The mobile commercial dryer probably is the most efficient method of preserving surpluses, particularly when they are comparatively small and in out-of-the-way places such as several miles from rail or good highway transportation. This type would be especially useful where there is only one crop available. The season would probably be short so that if the crop were fairly

small, it would not warrant the establishment of a large commercial dehydrator.

The mobile type is usually in batch cabinet form but drum dryers also have been designed to operate very efficiently. The usual practice is to mount the dryers on large trucks, the motor being used for power. A portable boiler is included with the equipment. A complete outfit, capable of producing 3000 pounds daily usually requires three trucks, the second carrying the preparatory, and the third the packaging equipment. All the trucks are hooked together to make the operation continuous and completely under cover. More expensive outfits include air-conditioning of the packaging room, and a fourth truck for hauling supplies. Upon arrival at the dehydration plant, this is unloaded and used for transporting the finished, packaged material to the warehouse or shipping point. There is every reason to believe that the success attained by the few trial units in operation will cause many more to be built in the not too distant future.

In the construction of such outfits, it is important to have complete equipment. Small packaging cannot be done successfully. The most common method is to pack the finished product in 30-gallon steel drums sealed tight with rubber gaskets. These are then shipped to the main plant of the manufacturer and packed for the commercial trade. It is claimed that this type of operation reduces the cost of raw materials and also the cost per finished pound. A crew of six men handles the entire process. It should be noted that a supply of water is essential for this operation.

All such units now in operation are owned by manufacturers who use them as auxiliaries of their main plants. It is thought, however, that communities, farmers' cooperatives, and so forth, could use this type of operation to supplement community drying. The objective would be to produce foods for the open market rather than to have each individual farmer dehydrate for his personal use. The lack of uniformity in such operations might have a tendency to make the products difficult to sell until the method has been developed further.

**Aims of Improved Methods.**—The 12 unproved types of dehydration mentioned earlier in this chapter all have the same purpose and that is to produce a dried food which will have the following characteristics, all of which the industry believes are essential qualities for the perfect food:



Makings of beef stew for 12 people can be carried in a lady's handbag when in compressed dehydrated form. (Courtesy Du Pont Co.)

1. Lower moisture content. 1% instead of 3% to 5% as at present.
2. Shorter drying time, less heat.
3. More complete destruction of enzymes of the lesser known varieties.
4. Immediate reconstitution without soaking or cooking.
5. Greater retention of vitamins, flavor and food values.

These qualities developed to the full, plus improved packaging which will eliminate all dangers of oxidation and afford protection at fairly high storage temperature, would give the dehydrated food industry every advantage it needs to be a very effective third form of food preservation.

**Unsolved Problems of Dehydration.**—The industry has problems and important ones which have not been solved but which must be if it is to maintain the present \$800,000,000 market volume or eventually exceed it in the commercial field.

The great difficulty is to remove the water, and, at the same time, maintain a delicate balance between the various important steps involved, all of which affect the food in different ways. We are trying to retain color, flavor, vitamin content, and other nutritive values and also to keep these qualities for a long period of time after processing.

There are certain steps which can be taken to prevent injury to one characteristic but which will affect others. It is impossible, by any known method, to take a perfect fruit or vegetable, remove all but 2% to 3% of the water, and retain exactly the original food values and other characteristics. A little bit must be sacrificed just as in canning or in freezing. The use of sulphur compounds, gases like  $\text{CO}_2$  and nitrogen have both advantages and disadvantages. They may help to preserve the color and destroy the vitamins, or in some cases, just the reverse.

If the maximum amount of moisture is removed, the product may keep a little longer but the flavor may be affected. If the last ounce of water is not taken out, a little time and money are saved for it is more difficult and expensive to get out the last 5% than the first 90%. However, laxity in this specification means that the product probably will not keep as well. If the last few percentages of water are removed in a drying bin instead of by the first direct dehydrating process, time and money are saved

but the vitamin content may be injured and there is a chance of developing mold in some products.

Blanching is extremely necessary in most cases. This is a rather delicate operation. The timing is very important, also the temperatures. Under-blanching will fail to kill all the enzymes and the food will deteriorate rapidly. If over-blanching, the vitamins will be destroyed.

**Lack in Uniformity.**—The weaknesses in processing, then, are the lack of uniform products and the necessity for extreme care in each operation with very nearly hair-trigger controls. With the best equipment and skilled labor, these difficulties are not insurmountable. But, today, dehydrators are having a hard time in obtaining a uniform product due to insufficient experience with the variables found in the fruits and vegetables, even those coming from the same field on the same day. The green help with which they have to work is another burden. This, coupled with the types of equipment which war restrictions have forced upon them, makes possible only an 80% product.

The problems of manufacture are not the greatest difficulties the dehydrator has to face. As yet, it is not known what causes the deterioration of dehydrated foods as evidenced by the hay odor or flavor which occasionally is noticed. Whether it is due to a little known enzyme which is not killed even by the most efficient operation, or whether it is in some step of the process or packaging, more research and experiment will have to determine definitely.

In laboratory tests made under the most exacting circumstances, it has been found that cranberries retain color, flavor and as much as 96% of the original vitamin content after three years. Products dried by standard commercial machines, under the same approximate conditions as nearly as could be determined, have shown a deterioration of about 25% in their general characteristics, including loss of vitamin content, in a period of one to two years.

The average dehydrated food, as produced commercially today, will show a deterioration of approximately 40% in nine to twelve months. The best goods on the market will show a deterioration of 20% in twelve to fifteen months. Generally speaking, the high acid products hold their vitamin content for a longer period without serious loss. Also, fruits are easier to dehydrate and have a longer shelf-life than vegetables.

The shelf-life of eggs is from five to nine months. Whole milk must be packed very carefully in vacuum. Dried skim milk has a fairly long shelf-life depending on storage conditions.

It may take years to prove what causes well packed foods to deteriorate. However, the progress which has been made in the last twelve months ensures the industry of being able to process and to pack foods which will remain good for more than the average length of time necessary to market them properly. Improvements made through scientific research will not add to the original color and flavor but probably will maintain them and other characteristics for a longer and longer period of time, making dehydration more and more valuable in the preservation of surpluses.

**Other Weaknesses in the Industry.**—Weaknesses in the industry, other than those caused by lack of knowledge of what happens to food when it is dehydrated, are those found in any new field which has had a mushroom growth. Many plants have been constructed poorly and in the wrong locations. The companies have no permanent established relationships with fruit and vegetable growers. The managements buy in the open market wherever they can obtain supplies. Contracts are made to produce more dried poundage than there are materials available within a reasonable radius of the plant. This means that the manufacturer must process a wide variety of material so lacking in uniformity as to make a uniform finished product practically impossible. There is a wide variance between the chemical characteristics of onions, carrots, or potatoes, for example, grown in one district and those in another. Hence, it is necessary for a manufacturer to have had long experience with each type and variety in order that compensations can be made in the dehydration process and uniformity established. Dehydrators, eventually, will maintain the same relationship with growers as do the canners. They will provide seeds and fertilizer and the same product will be grown everywhere under as similar conditions as possible. The result will be a greatly improved product.

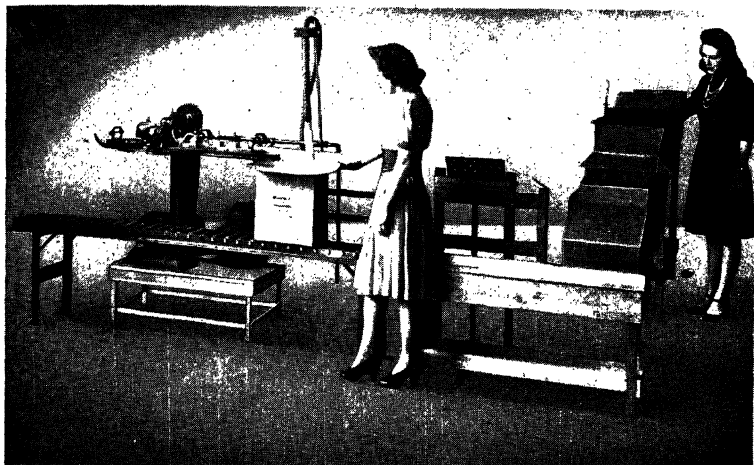
**Applications of Products Must Be Studied.**—The industry has not yet been able to give the time and attention necessary to develop different foods for different uses. It has been customary to make only one class of product which, although it varies a great deal, is designated a single type by the manufacturer. This may be all right for the soup-maker and for the baker, but it may be very poor for the housewife although it is sold to meet all three specifications. In other words, too much is claimed for it. All

foods cannot be dehydrated with equal success nor can they be used everywhere. The industry must spend more time determining how its foods may be used, where, and when. More information should be given the consumer in order that the most intelligent use may be made of the product. These are, in a sense, marketing problems but they also indicate where the industry itself can be improved by good manufacturing.

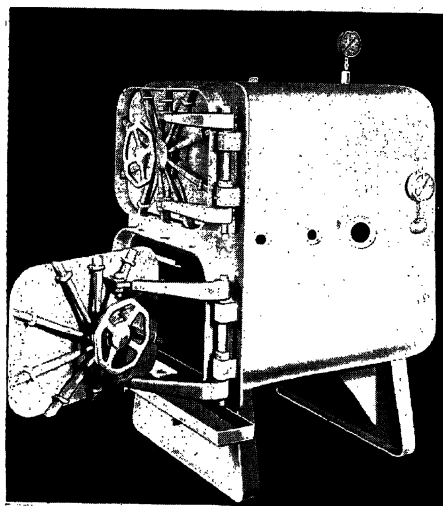
Also a selling problem, and an important one, is the lack of stability in the industry. Too many people are in dehydration just for the duration of the war. Their sole purpose is to make money and, perhaps, to help the government to fill an emergency need. In the main, their approach is to produce as much food as they possibly can that will get by government inspection. A large number of these manufacturers have a tendency to discourage those in the field for the long pull, causing them to hold back some of the permanent improvements that might otherwise be installed at considerable expense. Many of the temporary dehydrators are opportunists of the first order. They will pay any price for their raw materials as long as they can get a little bit more from the government for the finished product. Pressure for volume is the determining factor. This has created a bad price structure in the industry which is confusing to manufacturer and consumer alike.

**Importance of Higher Quality Standards.**—The marginal volume producer, looking only to government business, generally cuts all the corners, spends no unnecessary money on perfection of detail and, frequently, has products just fail to meet specifications. The off-test products are sold immediately to the hungry consumer market at whatever price the manufacturer can get. Usually this exceeds what is paid by the government. Such a haphazard price structure has tended to create the impression that dehydrated foods are not cheap because they do not save any money for the consumer. Instances are known where sweet potatoes, for example, have been contracted for by the government at 35¢ per pound. The marginal manufacturer lost money in the operation. Some of his products did not meet specifications and were placed on the commercial market at a price of 60¢ and even 70¢ a pound. When the good manufacturer, generally obtaining 35¢ a pound, saw his competitor selling an inferior product at 25¢ more, naturally he was inclined to be discouraged about the advantages of quality. Eventually, however, the marginal operator will not be able to sell his goods at all in the commercial market.

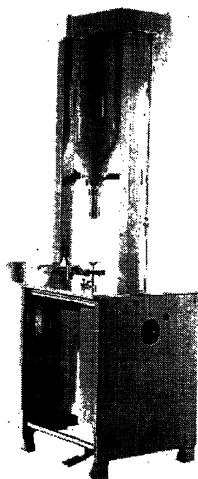
# TYPES OF EQUIPMENT USED



A modern bag packaging unit including a rotary sealer, roller conveyor, vacuum unit and loader. (Courtesy Amsco Packaging Machinery, Inc.)



Retort type blancher built in two sections. (Courtesy The Cleaver-Brooks Co.)



A filling machine used in dehydration plants. (Courtesy Stokes & Smith Co.)



The government has not recognized to any extent the difference in the manufacturing ability of suppliers. Certain reasonable standards have been set and approximately the same price paid to all. If recognition of superior processing ability can be obtained, it will be when there are more manufacturers and available supplies than the immediate market requires. From that time on, it is hoped that the higher standards of quality, which are possible, will prevail.

**Quality—The Post-War Answer.**—In recent months many of the leading corporations in the food industry have entered the dehydration field. The majority, formerly, had had too little capital and inadequate funds for proper advertising and selling. Therefore, when the real competition starts after the war, many will have to go out of business. In the meantime, it is to be expected that there will be price-cutting and a general tendency to offer cut-rate goods. Dehydration will have to weather the storm as the automobile and canning industries have done. One standard of excellency or a uniform high quality in all the goods produced by the entire industry can never be maintained. The problem is to prove that there are two grades: the good and the second-rate. This can be done only by an educational campaign with proper merchandising and selling. The housewife must be made to try not one but three or four or a dozen different dehydrated foods until she learns to discriminate, as she does in the selection of established brands of other processed foods.

The industry needs an American or Continental Can Company to guide it and to support it as in the case of the canning industry. A corporation, of greater strength than the dehydrators as a group, must assume the burden of constant research. Without such a foster-father, the scientific problems involved such as those relating to the growth and preparation of raw materials, processing and packaging, will be slow in finding solutions.

Such an organization might be a strong, virile association of all dehydrators. A national association has been established, but, as in similar cases, it is difficult to get the requisite amount of funds. As a rule, only a few of the more forward thinking manufacturers will take an active part in such a group. There are always a large number of free riders. Generally, there is a limit to the amount of goodwill industry work that the few will do for the many. A corporation has a sharper ax to grind. It gets a profit from sales

to industry. If it increases sales, it will increase profits. An association works for less tangible gains.

**Standardization of Dehydration Methods.**—Problems relating to the industry which can be solved better outside than within are those concerned with the development of uniform types of equipment. Manufacturers interested in the field should get together and establish the best method for dehydrating each kind of fruit and vegetable. Many people who would like to enter dehydration are holding back because they believe that the purchase of equipment today which has not been proved to be the best may require heavy write-offs on their books for obsolescence within a short time. Their capital being limited, they know they cannot re-equip their plants. The lack of interest in exchanging information applies not only to the makers of the actual dehydrating equipment but equally to preliminary handling controls and packaging machinery firms.

In the chemical field, many large corporations have become interested in the development of different products which might add to the palatability and general quality of dehydrated foods. Many preservatives have been tried from time to time such as anti-oxidants. Perhaps, eventually, the chemists will find the right answer to food preservation. It will be a most profitable discovery because anything which tends to improve the dehydrated product undoubtedly will cause the industry to go ahead by leaps and bounds.

**Opportunities Are There.**—Manufacturers of packaging material have spent hundreds of thousands of dollars trying to find the one perfect container. The corporation or individual who invents this should have a business as large and as profitable as that of a can manufacturer today. With such an incentive, it is quite possible that a package will be found superior to anything yet available except the tin can. Such a discovery is apt to push the entire industry ahead in volume and prestige.

When dehydrators first entered the field in volume, they were obliged to use the same varieties of fruits and vegetables as the canners since more was known about them than the others. Differences in quality, which would result in better dehydrated products, were not known. The industry, now, must make its own determination of the proper varieties for processing. The final answer, as we have indicated previously, can only be obtained after what may be years of research.

The various weaknesses cited here have been mentioned largely to show how the industry may help itself to grow tremendously, and why opportunities for a large and profitable business may not be far away. War, as we have said before, is the period which brings out the best inventive genius in man. Under the pressure of the present emergency, a number of these problems may be solved within a year or so. It took several years for one large corporation and a great many millions of dollars to discover and to overcome the problems of frozen foods. Once these weaknesses were mastered, the growth of the industry was enormously accelerated.

It has been said often that the time to enter an industry is before it has been developed completely and established. At that time, the market has been built and it costs much more to get in to take it away from existing manufacturers. By starting when the field has scarcely been scratched, there is an opportunity to grow automatically with the industry, and every year, as the total volume of sales increases, to obtain a fair percentage.

There are today more dehydrating plants in the country than freezing, eliminating local locker plants, but there are more than four times as many canneries. Analyzing the good and the bad, the chances for and against, the conclusion is reached that opportunity is here. If more proof is needed, the long range planning commissions, which constantly study future developments for America, have listed dehydration as one of the ten great changes in manufacturing, distribution, or other ways of doing things, which may revolutionize our standard of living within the next decade.

The following pages contain a few tables and statistics together with other facts of the industry as it exists today. For exact technical data on operations, we refer you to the many standard publications on the subject. A list of some of these is appended.

## **Members of the National Dehydrators Association**

- Alaska Pacific Salmon Company  
Skinner Building, Seattle, Washington
- American Dietaids Company, Inc.  
176 S. Broadway, Yonkers, N. Y.
- American Food Dehydration, Inc.  
1636 N. Bonnie Beach Place, Los Angeles, Calif.
- American Processing Corporation  
4817 Baldwin Ave, Bronx, N. Y.
- Anabolic Food Products, Inc.  
514 Riverdale Drive. Glendale, Calif.
- Anheuser-Busch, Inc.  
St. Louis, Mo.
- Appella Corporation  
Selah, Wash.
- Auto-Ordinance Corporation  
80 Broadway, New York City
- Barker Foods Products Company  
6075 S. Normandie Avenue, Los Angeles, Calif.
- Basic Vegetable Products Company  
315 Montgomery Street, San Francisco, Calif.
- Baxter, H. C. & Bro.  
Brunswick, Maine
- Beech-Nut Packing Company  
Canajoharie, N. Y.
- Blue Lake Producers Cooperative  
Salem, Oregon
- Borden Company, The  
350 Madison Avenue, New York City
- Bowen Research Corporation  
Garwood, N. J.
- Bridges-Wilson Corporation  
206 Massachusetts Avenue, Arlington, Mass.
- Bruce's Juices  
Tampa, Florida
- Bryant Heater Company  
17825 St. Clair Avenue, Cleveland. Ohio
- Bulman's Ltd.  
Vernon, B. C., Canada
- Bussler, Martha E., Inc.  
321 Greenwich Street, New York City

- California Vegetable Concentrates, Inc.  
Clarendon & Cottage Streets, Huntington Park, Calif.
- Carrier Corporation  
Syracuse, N. Y.
- Chapman Dehydrater Company, Inc.  
Modesto, Calif.
- Chef Boy-Ar-Dee Quality Foods, Inc.  
Milton, Pa.
- Chicago Carton Company  
4200 S. Crawford Avenue, Chicago, Ill.
- C. I. T. Financial Corporation  
1 Park Avenue, New York City
- Cleaver Brooks Company  
(Food Equipment Division)  
430 E. Silver Spring Road, Milwaukee, Wis.
- Container Corporation of America  
111 W. Washington St., Chicago, Ill.
- Continental Foods, Inc.  
1500 Hudson St., Hoboken, N. J.
- Corona Dehydrating Company, Inc.  
P.O. Box 1, Corona, Riverside County, Calif.
- Cranberry Cannery, Inc.  
South Hanson, Mass.
- Crosse & Blackwell Company  
Baltimore, Md.
- Deerfield Packing Company  
630 Fifth Avenue, New York City
- Demartini, The L. Company  
275 Brannan Street, San Francisco, Calif.
- Doughnut Corporation of America  
393 Seventh Avenue, New York City
- Dry-Pack Corporation  
420 Madison Avenue, New York City
- Duff, P. & Sons, Inc.  
920 Duquesne Way, Pittsburgh, Pa.
- Dulany, John H. & Sons  
Fruitland, Md.
- Du Pont de Nemours, E. I. & Company, Inc.  
Wilmington, Del.
- Durkee Famous Foods  
82 Corona Avenue, Elmhurst, L. I., N. Y.

- Empire State Pickling Company  
Phelps, N. Y.
- Exact Weight Scale Company, The  
Columbus, Ohio
- Food Industries  
330 West 42nd Street, New York City
- Food Machinery Corporation  
Hoopeston, Ill.
- Foxboro Company, The  
Foxboro, Mass.
- Fremont Kraut Company  
Fremont, Ohio
- French Kitchen Foods Corporation  
Chatsworth, Calif.
- Gair, Robert Company, The  
155 East 44th Street, New York City
- General Foods Sales Company, Inc.  
250 Park Avenue, New York City
- General Mills, Inc.  
Chamber of Commerce Bldg., Minneapolis, Minn.
- Gentry, C. B. Company  
837-39 N. Spring Street, Los Angeles, Calif.
- Grass, I. J. Company  
6021-27 Wentworth Avenue, Chicago, Ill.
- Griscom & Company, Inc.  
29 Broadway, New York City
- Gumpert, S. Company, Inc.  
Ozone Park, L. I., N. Y.
- Heil Company, The  
Milwaukee, Wisconsin
- Heller, Walter & Co.  
105 W. Adams Street, Chicago, Ill.
- Huron Milling Company, The  
Harbor Beach, Mich.
- Hygrade Food Products Corporation  
30 Church Street, New York City
- Idaho Dehydrated Food Company  
24 California Street, San Francisco, Calif.
- Industrial Air Company  
Westwood, Mass.
- Interchemical Corporation  
75 Varick Street, New York City

- International Minerals & Chemical Corporation  
20 North Wacker Drive, Chicago, Ill.
- Kitchen Art Foods, Inc.  
226-232 W. Ontario Street, Chicago, Ill.
- LaChoy Food Products Inc.  
Archbold, Ohio
- Lestrade Brothers  
105 Hudson Street, New York City
- Link-Belt Company  
300 W. Pershing Rd., Chicago, Ill.
- Little & Company  
210 W. Ohio Street, Chicago, Ill.
- Louisville Drying Machinery Company  
Baxter & Hamilton Avenues, Louisville, Ky.
- Maine Dehydration Company  
117 Milk Street, Boston, Mass.
- Maine Food Processors, Inc.  
Stock Exchange Bldg., Baltimore, Md.
- Makepeace, A. D. Company  
Wareham, Mass.
- McCormick & Company, Inc.  
Baltimore, Md.
- Menasha Products Company, The  
Menasha, Wis.
- Metropolitan Packing Corporation  
483-89 Greenwich Street, New York City
- Milani, Louis Foods  
3825-3831 W. Lake Street, Chicago, Ill.
- Miller, L. N.  
Eugene, Oregon
- Milprint, Inc.  
431 W. Florida Street, Milwaukee, Wis.
- Model Packing Company  
1300 W. 8th Street, Los Angeles, Calif.
- Modine Mfg. Company  
Racine, Wis.
- National City Dehydrating Company  
Room 516, Bank of America Bldg., San Diego, Calif.
- National Egg Dryers, Inc.  
105 W. Adams Street, Chicago, Ill.
- National Onion Set Corporation  
Kenosha, Wis.

- Ohio Boxboard Company, The  
Rittman, Ohio
- Owatonna Canning Company  
Owatonna, Minn.
- Pfaudler Company, The  
89 East Avenue, Rochester, N. Y.
- Pittsburgh Plate Glass Company  
Grant Building, Pittsburgh, Pa.
- Quaker Oats Company  
141 W. Jackson Blvd., Chicago, Ill.
- Red Star Yeast & Products Company  
221 E. Buffalo St., Milwaukee, Wis.
- Ridenour, P. D. Company  
1505-B Merchandise Mart, Chicago, Ill.
- Ritter, P. J. Company  
Bridgeton, N. J.
- Riverbank Canning Company  
99 Hudson Street, New York City
- Roberts Dairy Company  
2901 Cuming Street, Omaha, Neb.
- Rogers Bros. Seed Company  
308 W. Washington Street, Chicago, Ill.
- Ross Packing Co.  
Selah, Washington
- Royal, Thomas M. & Company  
5800 N. Seventh Street, Philadelphia, Pa.
- S & W Fine Foods  
155 Berry Street, San Francisco, Calif.
- Salamonie Packing Company  
Warren, Indiana
- Sanib Corporation  
122 E. 42nd Street, New York City
- Sardik Food Products Corporation  
420 Lexington Avenue, New York City
- Sears, Roebuck & Company  
Chicago, Ill.
- Shellmar Products Company  
Mt. Vernon, Ohio
- Simplot Dehydrating Company  
Caldwell, Idaho
- Sokol & Company  
241 E. Illinois Street, Chicago, Ill.



- Stein-Hall Mfg. Company  
2841 S. Ashland Avenue, Chicago, Ill.
- Stokely Brothers & Company  
Indianapolis, Ind.
- Stokes, F. J. Machine Company  
Philadelphia, Pa.
- Sutherland Paper Company  
Kalamazoo, Mich.
- Taylor Instrument Company  
Rochester, N. Y.
- Texas Chemurgic Industries, Inc.  
Kirby Building, Dallas, Texas.
- Vacu-Dry Company  
950 56th Street, Oakland, Calif.
- Valley Evaporating Company  
Yakima, Washington
- Warriner Starch Company  
902 Whitney Building, New Orleans, La.
- Washington Dehydrated Food Company  
Yakima, Washington
- Wylar & Company  
1050 Fullerton Avenue, Chicago, Ill.

TABLE I

Typical Food Products Suitable for Dehydration; Methods Used; Varieties Suitable for Process;  
Major Growing Areas; How Products Are Used

Product	Type of Dryer Used			Varieties Suitable for Dehydration	Major Growing Areas	How Products Are Used
	Cabinet	Tunnel	Drum Spray Vacuum			
Vegetables:						
Beans, snap	*	*		Tendergreen, or Asgrow stringless green pod; Burpee stringless, green pod; Giant stringless; Full Measure; U. S. No. 5 Refugee; Idaho Refugee; Blue Lake; Kentucky Wonder.	Calif. N.Y. Wis. Md. La. Ore. Fla. N.J. N.C. S.C.	Vegetable Soup
Beets	*	*		Detroit Dark Red Morse Detroit; Ohio Canner.	N.Y. Wis. Ore. Mich. La. N.J. Penna. Tex.	Vegetable Salad

Product	Type of Dryer Used			Varieties Suitable for Dehydration	Major Growing Areas	How Products Are Used
	Cabinet	Tunnel	Drum Spray			
Cabbage	*	*		Savoy (green) ; Copenhagen (white) ; Danish; Domestic; Pointed Head.	N.Y. N.C. S.C. Va. Tenn. Wash. Tex. Ore. Penna.	Vegetable Cole Slaw
Carrots	*	*		Morse Red Corded Chantenay; Imperator; Mantes Early Scarlet Horn; Long Orange Morse Bunching.	N.Y. Ore. Wash. Ariz. Calif. Mich. N.J. Tex.	Vegetable Vegetable juice Salad Soup Seasoning
Corn	*	*	*	Golden Bantam; Country Gentleman.	Md. Iowa Minn. Wis. Ohio Ill. Ind. N.Y. Penna. Maine Wash. N.J.	Vegetable Soup

Product	Type of Dryer Used			Varieties Suitable for Dehydration	Major Growing Areas	How Products Are Used
	Cabinet	Tunnel	Drum Spray Vacuum			
Onions	*	*		The Ebenezer; White Portugal; Red Creole; White Creole; Early Yellow Globe; Mountain Danvers; Ohio Yellow Globe; Red Wethersfield; Southport Red, Yellow, White Globes; Brigham Yellow Globe; Yellow Globe Danvers.	Mass. N.Y. N.J. Mich. Ind. Minn. Colo. Idaho Calif. Tex. Ore. Wash.	Seasoning Soup Prepared meats Sauces Dressings Bakery products Ketchup
	*	*		Thomas Laxton; Alderman; Morse's Market; Little Marvel.	N.Y. Ill. Wis. Minn. Md. Utah Wash. Ore. Calif. Colo. Idaho	Vegetable Soup Salad
Peas	*	*	*			

Product	Type of Dryer Used			Varieties Suitable for Dehydration	Major Growing Areas	How Products Are Used
	Cabinet	Tunnel	Drum Spray Vacuum			
Potatoes: white	*	*	*	Irish Cobbler; Triumph; Green Mountain; Katadin; Russet Burbank; Rural Russet; Rural N. Y. No. 2; Early Ohio Chippewa; Idaho Russet; Oregon Gem; Klamath Russet.	Idaho Maine Wash. Ore. Calif. Colo. Neb. N.D. Minn. Wis. Mich. Ohio Penna. N.J. N.Y. N.C. Va. Ala. Fla. Ill. Ind. Iowa Ky. Mo. Tex. W. Va.	Vegetable Soup Prepared meats Flour Bakery products

Product	Type of Dryer Used			Varieties Suitable for Dehydration	Major Growing Areas	How Products Are Used
	Cabinet	Tunnel	Drum Spray	Vacuum		
Potatoes: sweet and yams		*	*	Nancy Hall; Myers' Early; Mullihan; Nameyita; Md. Golden; Puerto Rican; Md. Sweet; Key West; Jersey.	N.C. Tenn. S.C. Ga. Ala. La. Miss. Tex. Md.	Vegetable Sweet potato pie
Pumpkin	*	*	*	Connecticut Field; Boston Marrow; Golden Cushaw; Winter Luxury; California Cheese.	N.J. Ohio Ind. Ill. Wash. Ore.	Vegetable Pumpkin pie
Rutabagas	*			American Purple Top; Golden Neckless.	Wash. Calif.	Vegetable
Spinach	*	*	*	Long Standing Savoy Leaved; Virginia Savoy; Giant Thick Leaved (Nobel); Dark Green Prickly Seeded.	Tex. Calif. Penna. Va.	Vegetable Soup

Product	Type of Dryer Used			Varieties Suitable for Dehydration	Major Growing Areas	How Products Are Used
	Cabinet	Tunnel	Drum	Spray	Vacuum	
Squash	*	*		Golden Delicious; Delicious; Hubbard.	N.J. Ohio Ind. Ill. Wash. Ore.	Vegetable Squash pie
Tomatoes		*		Morse's Early Santa Clara Canner; Morse's 133-6; San Marzano; Marglobe; Rutgers; Greater Baltimore.	Calif. Ark. Va. Md. Ind. Ohio Penna. N.J. N.Y.	Soup Juice Sauce Ketchup Seasoning Salad Dressing Bakery products
Fruits: Apples	*	*	*	Cravenstein; Ben Davis; Stark; Baldwin; King; Wagner; Greenings.	N.Y. Penna. Md. Va. Wash. Ore.	Jelly Applesauce Apple pie Apple butter Prepared meats Bakery products Baby foods Health foods Pharmaceuticals
Apricots	*	*	*	Royal; Blenheim; Tilton.	Calif. Wash.	Bakery products Baby foods

Product	Type of Dryer Used			Varieties Suitable for Dehydration	Major Growing Areas	How Products Are Used
	Cabinet	Tunnel	Drum Spray Vacuum			
Bananas	*	*	*	Gros Michel; Cavendish; Lady Finger; Plantain.	Honduras Brazil Ecuador Mexico	Fountain drinks Bakery products Confections Desserts Health foods
Cranberries	*	*	*	Early Blacks; Howes.	Mass. N.J. Wis. Ore.	Jelly Sauce
Lemons			*	Eureka; Lisbon.	Calif. Fla. Tex.	Desserts Bakery products Lemonade
Peaches	*			<i>Freestone:</i> Lovell; Muir; Elberta. <i>Clingstone:</i> Phillips and other California mid- summer varieties.	Calif. Ore. Wash. Mich. Ga.	Jelly Jam Desserts Bakery products
Prunes	*	*	*	French; Imperial; Sugar; Robe de Sergeant.	Calif. Ore. Wash.	Baby foods Desserts Bakery products



Product	Type of Dryer Used				Varieties Suitable for Dehydration	Major Growing Areas	How Products Are Used
	Cabinet	Tunnel	Drum	Spray			
Raspberries:					Columbian.	Mich.	Ice cream mixes
Black						N.Y.	Fountain syrups
and red	*		*			Wash.	Desserts
						Ore.	Jams
							Bakery products
Strawberries	*		*		Marschall.	Wash.	Jam
						Ore.	Desserts
						N.Y.	Fountain syrups
						Fla.	Bakery products
						Md.	Ice cream mixes
Eggs:						Central	Bakery products
Whole				*		States;	Desserts
Yolks			*			Tex.	Omelettes
Albumen	*		*			N.Y.	Scrambled eggs
						Penna.	
Milk:						Central	Desserts
Skim				*		States;	Bakery products
Whole				*		N.Y.	Soups
Buttermilk			*			Penna.	Drinks
Malted							
Whey			*	*			
Meats:							
Pork	*		Rot-			Ill.	Meat loaf
Beef	*	ary				Wis.	Ground meat
						Mo.	Stews
						Kan.	Soup base
							Hamburgers

# TABLE II

## Geographic Distribution of Food Dehydrators in the United States (Exclusive of Milk Processors)

Alabama	1	Montana	1
Arizona	1	Nebraska	6
Arkansas	3	New Jersey	12
California	59	New York	38
Colorado	4	North Carolina	3
Florida	6	North Dakota	1
Georgia	8	Ohio	8
Idaho	11	Oklahoma	3
Illinois	20	Oregon	11
Indiana	12	Pennsylvania	12
Iowa	9	South Carolina	6
Kansas	6	South Dakota	1
Kentucky	1	Tennessee	5
Louisiana	8	Texas	19
Maine	10	Utah	1
Maryland	6	Vermont	1
Massachusetts	5	Washington	11
Michigan	7	Wisconsin	23
Minnesota	11		
Mississippi	2	Total dehydrators located	
Missouri	7	in 39 states	359

### TABLE III



**TABLE IV**  
**Dehydrated Commodities Purchased During September, 1943, for Lend-Lease, Territorial  
 Emergency, Red Cross and Other Purposes, as Reported by the War Food Administration.**

<i>Commodity</i>	<i>Quantity (lbs.)</i>		<i>F.O.B. Cost</i>	
	<i>September 1943</i>	<i>Cumulative since 3/15/41</i>	<i>September 1943</i>	<i>Cumulative since 3/15/43</i>
<b>Dairy &amp; Poultry:</b>				
Eggs, Dried .....	4,205,971	490,559,023	\$5,342,916	\$558,454,080
Milk, Dry Powder Mixture .....	.....	72,700	.....	15,695
Milk, Dry Skim (Roller) .....	7,748,962	234,677,232	968,786	28,088,817
Milk, Dry Skim (Spray) .....	10,267,840	253,127,598	1,488,746	35,325,686
Milk, Dry Whole .....	4,134,000	46,131,622	1,529,875	16,330,157
<b>Meats:</b>				
Beef .....	.....	90,248	.....	93,265
Pork .....	2,802,370	12,126,533	3,698,991	15,403,567
<b>Vegetables:</b>				
Beets .....	.....	518,400	.....	236,664
Cabbage .....	300,000	883,600	180,750	501,410
Carrots .....	2,239,278	8,710,258	934,197	3,672,357
Garlic (Powdered) .....	.....	978,840	.....	422,877
Julienne, Mixed .....	.....	8,000	.....	2,360
Onions .....	450,000	1,904,415	751,572	1,454,432
Potatoes, Sweet .....	750,000	750,000	255,000	255,000
Potatoes, White .....	1,827,154	13,482,543	804,343	4,892,715
Rutabagas .....	.....	250,000	.....	45,000
Spinach .....	.....	6,000	.....	4,740
Turnips .....	.....	116,200	.....	54,432
<b>Miscellaneous:</b>				
Soups .....	.....	9,190,000	.....	5,537,700
Soap Powders, Dry .....	.....	66,308,262	.....	12,032,228
Soup Flakes, Dehydrated Tomato .....	.....	2,004,500	.....	842,310
<b>TOTALS .....</b>	<b>34,725,575</b>	<b>1,141,895,974</b>	<b>\$15,955,176</b>	<b>\$693,665,492</b>

# TABLE V

**Amount of Dehydrated Vegetables (Containing About 5%  
Moisture) Required to Produce One Pound of  
Rehydrated Product**

## **TABLE VI**

### **List of Dehydrated Products**

According to the most recently published list of canned products, there are 207 different fruits and vegetables now being canned. This does not include all the endless varieties or grades. As a comparison, there are now being dehydrated 145 fruits, vegetables and other food items.

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whole	persimmons	seeds
buttermilk	peppermint	shrimp waste
malted	peppers	soup powders
whey	pimentoes	soybeans
mince meat (mock)	pork	spaghetti
molasses	potatoes:	spinach
mushrooms	white	squash
mustard greens	sweet	starch
nectarines	prunes	strawberries
noodles	psyllum seed	sugar
nuts	pumpkin	tomatoes
okra	radish	tomato juice
onions	raisin grapes	tomato catsup
orange juice	raspberries:	turnips
paprika	black	vinegar grains
parsley	red	walnuts
parsnips	rhubarb	watercress
peaches	rice	wheat
pears	rutabagas	yams
peas	salt	yeast
pectin	seasonings	



## TABLE VII

### List of Products Dehydrated in Foreign Countries

While much experimental work is now being done on a wide variety of products, the following are the only ones which have been sold commercially in any quantity. The list does not include products dehydrated in Europe of which there are as many varieties as are to be found in this country.

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## BIBLIOGRAPHY

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(C. C. Van Leer, Jr., in QUICK FROZEN FOODS.)

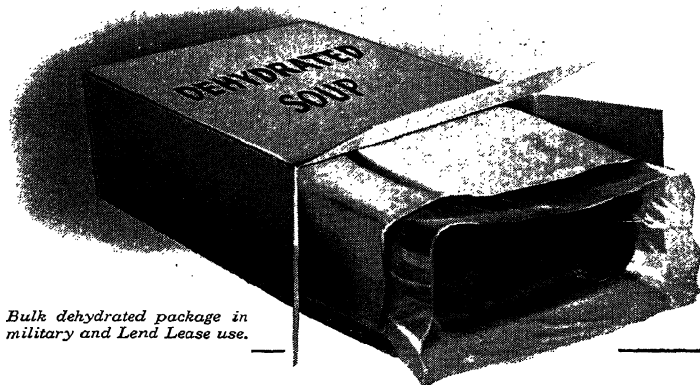
View of the enlisted men's mess where dehydrated foods made such a hit.



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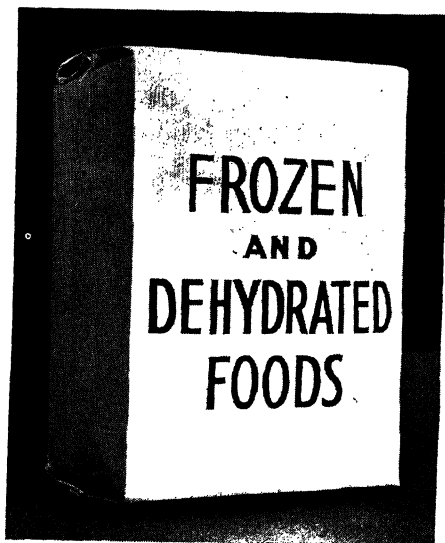
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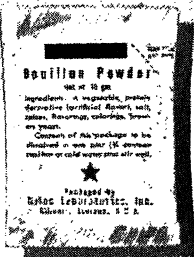
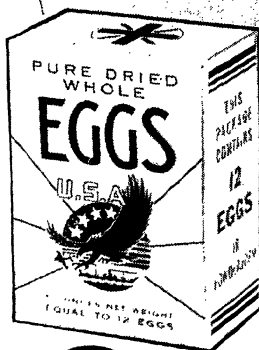
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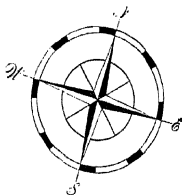
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